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# TRANSACTIONS

OF THE

# AMERICAN

# SURGICAL ASSOCIATION.

*VOLUME THE TWENTY-THIRD*

EDITED BY

RICHARD H. HARTE, M.D.,
RECORDER OF THE ASSOCIATION.

PRINTED FOR THE ASSOCIATION.

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## OFFICERS OF THE ASSOCIATION,

ELECTED JULY, 1905.

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ALBERT VANDER VEER, M.D.

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JOHN C. MUNRO, M.D.

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260 Euclid Ave., Cleveland.

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*Ex-officio.*

COMMITTEE ON NECROLOGY, CREATED IN 1884.
(Report by Title.)

F. H. GERRISH, M.D.,
N. B. CARSON, M.D.,
WM. L. RODMAN, M.D.

---

*Place of next meeting:*

CLEVELAND, OHIO, MAY 30, 31, and JUNE 1, 1906.

COMMITTEE OF ARRANGEMENTS.

F. E. BUNTS, M.D.,
GEO. W. CRILE, M.D.,
DUDLEY P. ALLEN, M.D., *Chairman.*

CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS
WASHINGTON, 1907.

*Delegate:* W. W. KEEN, M.D.
*Alternate:* A. J. McCOSH, M.D.

## LIST OF THE PRESIDENTS

OF THE

## ASSOCIATION FROM THE TIME OF ITS INSTITUTION.

ELECTED

1880. †SAMUEL DAVID GROSS, M.D., LL.D., D.C.L. Oxon., LL.D. Cantab., LL.D. Edin.—Founder of the Association.
1883. †EDWARD MOTT MOORE, M.D., LL.D.
1884. †WILLIAM THOMPSON BRIGGS, M.D.
1885. †MOSES GUNN, A.M., M.D., LL.D.
1886. †HUNTER McGUIRE, M.D., LL.D.
1887. †D. HAYES AGNEW, M.D., LL.D.
1888. DAVID WILLIAMS CHEEVER, M.D., LL.D.
1889. †DAVID W. YANDELL, M.D.
1890. †CLAUDIUS HENRY MASTIN, M.D., LL.D.
1891. PHINEAS SANBORN CONNER, M.D., LL.D.
1892. NICHOLAS SENN, M.D., Ph.D., LL.D.
1893. J. EWING MEARS, A.M., M.D.
1894. FREDERIC SHEPARD DENNIS, M.D.
1895. LOUIS McLANE TIFFANY, A.M. Cantab., M.D.
1896. JOHN COLLINS WARREN, M.D., LL.D. (Jefferson), Hon. F.R.C.S. Eng.
1897. THEODORE F. PREWITT, M.D.
1898. WILLIAM W. KEEN, A.M., M.D., LL.D., Hon. F.R.C.S. Eng.
1899. ROBERT F. WEIR, A.M., M.D., F.R.C.S. Eng.
1900. ROSWELL PARK, M.D.
1901. DE FOREST WILLARD, A.M., M.D., Ph.D.
1902. MAURICE H. RICHARDSON, A.B., M.D.
1903. NATHANIEL P. DANDRIDGE, M.D.
1904. GEORGE BEN JOHNSTON, M.D.
1905. ALBERT VANDER VEER, M.D.

† Deceased.

## NOTICE.

THIS volume of TRANSACTIONS contains the papers read before the Association at the Meeting held July 5, 6, and 7, 1905.

The Association assumes no responsibility for the statements and opinions published in this volume.

# FELLOWS

OF THE

# AMERICAN SURGICAL ASSOCIATION.

JULY, 1905.

* Denotes Original Fellows.

ELECTED

1890. ABBE, ROBERT, M.D., 13 West Fiftieth Street, New York. Surgeon to St. Luke's Hospital. *Vice-President*, 1901.

1894. ALLEN, DUDLEY P., A.M., M.D., *Secretary*, 1110 (old 260) Euclid Ave., Cleveland, Ohio. Professor of Surgery, Medical Department of Western Reserve University; Visiting Surgeon, Lakeside and Charity Hospitals; Consulting Surgeon to the Cleveland City Hospital.

1890. ALLIS, OSCAR HUNTINGTON, A.M., M.D., 1604 Spruce Street, Philadelphia. Surgeon to the Presbyterian Hospital.

1902. ANDREWS, E. WYLLYS, A.M., M.D., 2525 Prairie Avenue, Chicago, Ill. Professor of Surgery, Northwestern University Medical School; Surgeon to Mercy Hospital and Michael Reese Hospital; Attending Surgeon to Cook County Hospital; Consulting Surgeon to the Provident Hospital.

1901. ARMSTRONG, GEORGE E., C.M., M.D., 320 Mountain Street, Montreal. Associate Professor of Clinical Surgery, McGill University; Surgeon to the Montreal General Hospital; Surgeon to the Western Hospital, Montreal.

1882. BARTON, JAMES M., A.M., M.D., 1337 Spruce Street, Philadelphia. Surgeon to the Jefferson Medical College Hospital and to the Philadelphia Hospital.

ELECTED

1901. Bell, James, M.D., *Vice-President*, 873 Dorchester Street, Montreal. Professor of Clinical Surgery, McGill University; Surgeon to the Royal Victoria Hospital.

1900. Bevan, Arthur Dean, M.D., 100 State Street, Chicago. Associate Professor of Surgery, Rush Medical College, University of Chicago; Surgeon to Presbyterian Hospital.

1901. Binnie, J. F., M.B., C.M. (Aberdeen), Twelfth and Wyandotte Streets, Kansas City, Mo. Professor of Surgical Pathology and Clinical Surgery, Kansas City Medical College.

1902. Blake, Joseph A., M.D., 601 Madison Avenue, New York. Instructor in Surgery, Columbia University; Attending Surgeon to St. Luke's Hospital; Junior Surgeon to the Roosevelt Hospital; Consulting Surgeon to the Northern Dispensary.

1901. Bloodgood, Joseph C., B.S., M.D., 923 North Charles Street, Baltimore, Md. Associate in Surgery in the Johns Hopkins University.

1882. Bontecou, Reed Brockway, M.D., 82 Fourth Street, Troy, N. Y. Surgeon to the Marshall Infirmary.

1901. Bosher, Lewis C., M.D., 717 East Franklin Street, Richmond, Va. Professor of Surgery, Medical College of Virginia; Surgeon to the Old Dominion Hospital.

1890. Bradford, Edward Hickling, A.B., M.D., 133 Newbury Street, Boston. Surgeon to the Children's and the Samaritan Hospitals; Assistant Professor of Orthopedic Surgery in the Harvard University.

1900. Brewer, George Emerson, M.D., 61 West Forty-eighth Street, New York City. Professor of Clinical Surgery in College of Physicians and Surgeons, Columbia University; Junior Surgeon, Roosevelt Hospital; Attending Surgeon, City Hospital; Consulting Surgeon to the Ophthalmic and Aural Institute, and to the Perth Amboy Hospital.

*1880. Brinton, John H., M.D., 1423 Spruce Street, Philadelphia. Professor of the Practice of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital. *Treasurer*, 1884–85.

1895. Bryant, Joseph D., M.D., 32 West Forty-eighth Street, New York. Professor of Anatomy and of Operative and Clinical Surgery, Bellevue Hospital Medical College; Surgeon to Bellevue and St. Vincent's Hospitals; Consulting Surgeon to Gouverneur Hospital, Hospital for Ruptured and Crippled, St. Joseph's and Hackensack Hospitals, Asylum for Insane, New York, etc.

ELECTED

1882. Bull, William Tillinghast, A.B., M.D., 35 West Thirty-fifth Street, New York. Adjunct Professor of the Practice of Surgery and of Clinical Surgery in the College of Physicians and Surgeons, New York; Surgeon to the New York and St. Luke's Hospitals; Consulting Surgeon to the Hospital for Ruptured and Crippled, and to the New York Cancer Hospital.

1900. Bunts, Frank E., M.D., 275 Prospect Street, Cleveland, Ohio. Professor of Principles of Surgery and Clinical Surgery in Medical College of Western Reserve University; Visiting Surgeon to St. Vincent's Charity Hospital; Consulting Surgeon to Cleveland City and Lutheran Hospitals.

1893. Burrell, Herbert Leslie, M.D. (Harvard), 22 Newbury Street, Boston, Mass. Assistant Professor of Surgery in Harvard University; Visiting Surgeon, Boston City Hospital; Visiting Surgeon to the Children's Hospital; Consulting Surgeon, Carney Hospital and the Quincy Hospital. *Secretary*, 1895–1901.

1889. Cabot, Arthur Tracy, A.M., M.D., 1 Marlborough Street, Boston, Mass. Surgeon to Massachusetts General Hospital.

1885. Carmalt, William H., A.M., M.D., 87 Elm Street, New Haven, Conn. Professor of Surgery in Yale University; Surgeon to the New Haven Hospital. *Vice-President*, 1895.

1896. Carson, Norman Bruce, M.D., 303 Humboldt Bldg., St.Louis, Mo. Professor of Clinical Surgery in the St. Louis Medical College; Surgeon to St. Louis and Mullanphy Hospitals and to the St. Vincent Insane Asylum, etc. *Vice-President*, 1903.

1882. Cheever, David Williams, M.D., LL.D., 557 Boylston Street, Boston, Mass. Professor of Surgery (Emeritus) in Harvard University; Surgeon to Boston City Hospital. *President*, 1888.

1896. Cole, Charles Knox, A.M., M.D., Helena, Montana. Surgeon to St. John's, St. Peter's, and County Hospitals.

1898. Coley, William B., M.D., 5 Park Avenue, New York. Attending Surgeon to the General Memorial Hospital; Associate Surgeon to the Hospital for Ruptured and Crippled, New York.

*1880. Conner, Phineas Sanborn, M.D., LL.D., 215 West Ninth Street, Cincinnati, Ohio. Professor of Surgery in the Medical College of Ohio; Emeritus Professor of Surgery, Dartmouth Medical College; Surgeon to the Cincinnati and the Good Samaritan Hospitals. *President*, 1891; *Member of Council*, 1883 and 1895–1900; *Treasurer*, 1885–91.

ELECTED

1905. Crile, George W., M. D., 275 Prospect St., Cleveland, Ohio. Professor of Clinical Surgery, Western Reserve Medical College; Visiting Surgeon to St. Alexis Hospital; Associate Surgeon to Lakeside Hospital.

1896. Curtis, Benjamin Farquhar, A.B., M.D., 7 East Forty-first Street, New York. Professor of the Principles of Surgery and Clinical Surgery, University and Bellevue Hospital Medical College of New York; Attending Surgeon to St. Luke's and Bellevue Hospitals, and the General Memorial Hospital for Treatment of Cancer and Allied Diseases; Consulting Surgeon to New York Orthopedic Hospital and Dispensary.

1896. Cushing, Hayward Warren, A.B., M.D., 70 Commonwealth Avenue, Boston, Mass. Junior Visiting Surgeon, Boston City Hospital; Assistant Surgeon, Children's Hospital, Boston.

1897. Da Costa, John Chalmers, M.D., 2045 Walnut Street, Philadelphia, Pa. Clinical Professor of Surgery, Jefferson Medical College; Surgeon to the Philadelphia and the Phœnixville Hospitals.

1883. Dandridge, Nathaniel Pendleton, M.D., 422 Broadway, Cincinnati, Ohio. Professor of Practice of Surgery and of Clinical Surgery in the Miami Medical College, Cincinnati. *President*, 1904. *Treasurer*, 1894–96. *Member of Council*, 1904.

1892. Deaver, John B., M.D., 1634 Walnut Street, Philadelphia. Surgeon-in-Chief to the German Hospital, Philadelphia.

1882. Dennis, Frederic Shepard, M.D., F.R.C.S. Eng., 542 Madison Avenue, New York. Professor of Clinical Surgery, Cornell University, New York City; Visiting Surgeon to the Bellevue and St. Vincent's Hospitals; Consulting Surgeon to St. Joseph's Hospital, Yonkers, and Montefiore Home, New York City. *President*, 1894; *Vice-President*, 1887; *Member of Council*, 1889.

1901. Eliot, Ellsworth, Jr., M.D., 48 West Thirty-sixth Street, New York. Clinical Lecturer and Demonstrator of Surgery, College of Physicians and Surgeons, New York; Surgeon to the Presbyterian Hospital.

1893. Elliot, John Wheelock, A.M., M.D. (Harvard), 124 Beacon Street, Boston. Surgeon to Massachusetts General Hospital.

1896. Estes, William Lawrence, A.M., M.D., South Bethlehem, Pa. Director and Surgeon-in-Chief of St. Luke's Hospital; Lecturer on Hygiene at Lehigh University.

1898. Eve, Duncan, A.M., M.D., 700 Church Street, Nashville, Tenn. Professor of Surgery and Clinical Surgery, Medical Department, Vanderbilt University; Surgeon to the Nashville City Hospital.

ELECTED

1901. Ferguson, Alex. Hugh, C.M., M.D., 10 Drexel Square, Chicago, Ill. Professor of Clinical Surgery in the Medical Department of the University of the State of Illinois; Professor of Surgery in the Post-Graduate Medical School of Chicago; Surgeon-in-Chief of the Chicago Hospital; Surgeon to Cook County Hospital for the Insane; Consulting Surgeon to Provident Hospital.

1899. Finney, John M. T., M.D., 1300 Eutaw Place, Baltimore, Md. Associate Professor of Surgery, Johns Hopkins University.

1882. Forbes, William Smith, M.D., 901 Pine Street, Philadelphia. Professor of Anatomy in the Jefferson Medical College of Philadelphia.

1891. Fowler, George Ryerson, M.D., *Treasurer*, 301 De Kalb Avenue, Borough of Brooklyn, New York City. Professor of Surgery, New York Polyclinic; Examiner in Surgery, Medical Examining Board of Regents, University of State of New York; Surgeon to the Methodist Episcopal, German, and Brooklyn Hospitals; Consulting Surgeon to St. Mary's and Norwegian Relief (E. D.) Hospitals.

1904. Frazier, Charles Harrison, M.D., 1724 Spruce Street, Philadelphia, Pa. Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the University Hospital.

1898. Freeman, Leonard, B.S., M.D., 1801 Franklin Street, Denver, Col. Professor of Surgery, Gross Medical College ; Surgeon to the Arapahoe County Hospital and to St. Anthony's Hospital.

1882. Gay, George Washington, A.M., M.D., 665 Boylston Street, Boston, Mass. Senior Surgeon to the Boston City Hospital; Clinical Instructor in Surgery in Harvard University. *Member of Council*, 1882.

1892. Gerrish, Frederic Henry, A.M., M.D., 675 Congress Street, Portland, Maine. Consulting Surgeon, Maine General Hospital; Professor of Anatomy in Medical Department of Bowdoin College.

1890. Gerster, Arpad G., M.D., Chir. D., 34 East Seventy-fifth Street, New York. Professor of Surgery in the New York Polyclinic; Surgeon to the German and Mount Sinai Hospitals.

1892. Halsted, William Stewart, B.A., M.D., 1201 Eutaw Place, Baltimore, Md. Surgeon to Johns Hopkins Hospital.

ELECTED

1898. HARRINGTON, FRANCIS B., A.B. (Tufts College), M.D. (Harvard College). 201 Beacon Street, Boston, Mass. Surgeon to Massachusetts General Hospital.

1900. HARRIS, MALCOLM L., M.D., 612 Reliance Building, Chicago, Ill. Professor of Surgery, Chicago Polyclinic; Attending Surgeon, Alexian Brothers' Hospital, St. Luke's Hospital, and Maurice Porter Hospital for Children.

1895. HARTE, RICHARD H., M.D., *Recorder*, 1503 Spruce Street, Philadelphia. Associate Professor of Surgery, University of Pennsylvania; Surgeon to the Pennsylvania Hospital, and Orthopædic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to St. Mary's, St. Timothy's, and Bryn Mawr Hospitals.

1898. HEARN, W. JOSEPH, M.D., 1120 Walnut Street, Philadelphia. Clinical Professor of Surgery, Jefferson Medical College; Visiting Surgeon to the Philadelphia Hospital; Consulting Surgeon to the Phœnixville General Hospital.

1899. HORWITZ, ORVILLE, M.D., 1721 Walnut Street, Philadelphia. Clinical Professor of Genito-Urinary Diseases, Jefferson Medical College; Surgeon to the Philadelphia Hospital; Consulting Surgeon to State Hospital for Insane and Hayes Mechanics' Home.

1901. HUNTINGTON, THOMAS W., A.B., M.D., 1118 Sutter Street, San Francisco, California. Professor of Clinical and Operative Surgery, Medical Department, University of California; Visiting Surgeon to the City and County Hospital, San Francisco; Consulting Surgeon, St. Luke's Hospital, San Francisco.

1901. JACOBSON, NATHAN, M.D., 430 South Salina Street, Syracuse, N. Y. Professor of Clinical Surgery, College of Medicine, Syracuse University; Surgeon to St. Joseph's Hospital.

1901. JOHNSON, ALEXANDER B., M.D., 12 East Fifty-eighth Street, New York. Professor of Clinical Surgery, Cornell University Medical College ; Attending Surgeon to New York Hospital.

1905. JOHNSON, ROBERT W., A.B., M.D., 101 W. Franklin Street, Baltimore, Md. Professor of Principles and Practice of Surgery, Baltimore Medical College; Surgeon to Maryland General Hospital; Church Home and Infirmary; St. Agnes' Hospital.

1896. JOHNSTON, GEORGE BEN, M.D., *President*, 405 East Grace Street, Richmond, Va. Professor of the Practice of Surgery

ELECTED

and of Clinical Surgery in the Medical College of Virginia; Surgeon to the Old Dominion Hospital, and Consulting Surgeon to the Richmond City Free Dispensary.

1901. Jonas, A. F., M.D., 106 South Thirty-first Avenue, Omaha, Nebraska. Professor of Surgery, Omaha Medical College; Surgeon to the Methodist Episcopal Hospital and to the Douglas County Hospital.

1899. Kammerer, Frederick, M.D., 51 East Sixty-sixth Street, New York City. Professor of Clinical Surgery, Cornell Medical College; Surgeon to the German and St. Francis' Hospitals, New York.

*1880. Keen, William Williams, A.M., M.D., LL.D., Hon. F.R.C.S., Eng., 1729 Chestnut Street, Philadelphia. Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Jefferson Medical College Hospital; Consulting Surgeon to the Woman's and St. Agnes' Hospitals; Membre Correspondant Etrangé de la Société de Chirurgie de Paris; Membre Honoraire de la Société Belge de Chirurgie. *President*, 1898; *Vice-President*, 1892; *Member of Council*, 1899–1901.

1901. La Garde, Louis A., M.D., United States Soldiers' Home, Washington, D. C. Professor of Military Surgery, New York University and Bellevue Hospital Medical College; Major and Surgeon United States Army.

1901. Le Conte, Robert G., A.B., M.D., 1530 Locust Street, Philadelphia. Associate Professor of Surgery, University of Pennsylvania; Surgeon to the Pennsylvania, the Children's, and the Bryn Mawr Hospitals.

1903. Lutz, F. J., A.M., M.D., 3337 Lafayette Place, St. Louis, Mo. Professor of Surgery, Medical Department, St. Louis University; Surgeon-in-Chief, Alexian Brothers' Hospital; Surgeon-in-Charge, Josephine Hospital.

1901. McArthur, L. L., M.D., 4415 Drexel Building, Chicago, Ill. Professor of Clinical Surgery, Post-Graduate Medical School; Assistant Professor of Clinical Surgery, Rush Medical College; Surgeon to St. Luke's and Michael Reese Hospitals.

1896. McCosh, Andrew J., B.A., M.D., 16 East Fifty-fourth Street, New York. Surgeon to the Presbyterian Hospital; Clinical Lecturer on Surgery, College of Physicians and Surgeons.

1882. McGraw, Theodore A., M.D., 73 Case Street, Detroit,

ELECTED

Michigan. Professor of Surgery in the Detroit Medical College; Surgeon to St. Mary's and Harper Hospitals. *Vice-President*, 1896.

1903. McMURTRY, LEWIS S., A.M., M.D., 1912 Sixth Street, Louisville, Ky. Professor of Gynecology and Abdominal Surgery, Hospital of Medicine, Louisville, Ky.

1901. MACDONALD, WILLIS G., M.D., 27 Eagle Street, Albany, New York.

1904. MACLAREN, ARCHIBALD, M.D., B.S., 350 St. Peter Street, St. Paul, Minn. Professor of Clinical Surgery, University of Minnesota.

1899. MARKOE, FRANCIS H., M.D., 15 East Forty-ninth Street, New York. Professor of Clinical Surgery, Medical Department, Columbia University, New York City; Attending Surgeon, St. Luke's and New York Hospitals; Consulting Surgeon, Orthopædic Hospital.

*1880. MARKS, SOLON, M.D., 136 Wisconsin Street, Milwaukee, Wis. Surgeon to St. Mary's Hospital. *Vice-President*, 1898.

1898. MARTIN, EDWARD, M.D., 1506 Locust Street, Philadelphia. Clinical Professor of Surgery, University of Pennsylvania; Clinical Professor of Surgery, Woman's Medical College, Philadelphia; Surgeon to Philadelphia, St. Agnes', and Howard Hospitals.

1887. MASTIN, WILLIAM MCDOWELL, M.D., Northeast corner of Joachim and Conti Streets, Mobile, Ala. Surgeon to the Mobile City Hospital.

1895. MATAS, RUDOLPH, M.D., 2255 St. Charles Avenue, New Orleans, La. Professor of Surgery, Medical Department, Tulane University; Professor of Clinical Surgery, New Orleans Polyclinic; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital. *Vice-President*, 1901.

1903. MAYO, CHARLES H., M.D., Rochester, Minn. Surgeon to St. Mary's Hospital.

1899. MAYO, WILLIAM J., A.M., M.D., 427 West College Street Rochester, Minn. Surgeon to St. Mary's Hospital. *Vice-President*, 1903.

*1880. MEARS, J. EWING, A.M., M.D., 210 South Seventh Street, Philadelphia. *President*, 1893; *Recorder*, 1881–93.

1901. MEYER, WILLY, M.D., 700 Madison Avenue, New York. Professor of Surgery in the New York Post-Graduate Medical School and Hospital; Attending Surgeon to the German

ELECTED

and New York Skin and Cancer Hospitals; Consulting Surgeon to the New York Infirmary for Women and Children.

1893. Mixter, Samuel Jason, S.B. (Massachusetts Institute of Technology), M.D. (Harvard), 180 Marlborough Street, Boston. Surgeon to Massachusetts General Hospital and to Carney Hospital; Consulting Surgeon to the Massachusetts Charity Eye and Ear Infirmary; Instructor in Surgery in the Harvard University.

1896. Monks, George Howard, A.B. (Harvard), M.D. (Harvard), M.R.C.S. Eng., 67 Marlborough Street, Boston. Surgeon to Carney Hospital; Assistant Visiting Surgeon, Boston City Hospital; Instructor in Clinical and Assistant in Operative Surgery, Harvard Medical School; Instructor in Surgical Pathology, Harvard Dental School.

1895. Moore, James E., M.D., 704 Pillsbury Street, Minneapolis, Minn. Professor of Surgery, University of Minnesota; Surgeon-in-Chief to the Northwestern Hospital.

1898. Morton, Thomas S. K., M.D., School Lane, Germantown, Philadelphia.

1904. Mudd, Harvey G., M.D., 2604 Locust Street, St. Louis, Mo. Professor of Fractures and Dislocations and Clinical Surgery, Medical Department, Washington University; Surgeon to St. Luke's Hospital; Consulting Surgeon to the St. Louis City Hospital.

1900. Munro, John C., M.D., 173 Beacon Street, Boston. Instructor in Surgery, Harvard; Professor of Surgery, Tufts College Dental School; Assistant Visiting Surgeon, Boston City Hospital.

1902. Murphy, John B., A.M., M.D., 100 State Street, Chicago, Ill. Professor of Surgery, Medical Department of Northwestern University, Chicago Post-Graduate School and Hospital, and Chicago Clinical School; Attending Surgeon to Mercy Hospital, Cook County Hospital, and Wesley Hospital; Consulting Surgeon to Alexian Brothers' Hospital and Hospital for Crippled Children.

1898. Murray, Francis W., M.D., 32 West Thirty-ninth Street, New York City. Professor of Clinical Surgery in Cornell University Medical College; Surgeon to the New York and St. Luke's Hospitals.

1882. Nancrede, Charles Beylard, A.M. (University of Pennsylvania), M.D., LL.D. (Jefferson), 720 South University

ELECTED

Avenue, Ann Arbor, Mich. Professor of Surgery in the University of Michigan; Professor of Surgery, Dartmouth Medical College. *Vice-President*, 1889 and 1899.

1903. Neilson, Thomas R., M.D., 122 South Seventeenth Street, Philadelphia, Pa. Surgeon to the Episcopal Hospital and to St. Christopher's Hospital for Children; Clinical Professor of Genito-Urinary Diseases in the University of Pennsylvania.

1900. Ochsner, A. J., B.S., F.R.M.S., M.D. Eng., 710 Sedgwick Street, Chicago. Professor of Clinical Surgery, College of Physicians and Surgeons; Surgeon-in-Chief of Augustana and St. Mary's Hospitals.

1900. Oliver, J. C., M.D., 628 Elm Street, Cincinnati, Ohio. Dean and Professor of Operative Surgery, Miami Medical College; Surgeon, Cincinnati, Presbyterian, and Christ Hospitals.

1905. Oviatt, Charles W., M.D., 500 Algoma Street, Oshkosh, Wis.

1882. Owens, John E., M.D., 1201 Venetian Building, Chicago, Ill. Professor of Principles and Practice of Surgery and Clinical Surgery in the Chicago Medical College; Surgeon to St. Luke's Hospital. *Vice-President*, 1900.

1899. Parham, Frederick William, M.D., 1429 Seventh Street, New Orleans, La. Professor of General Clinical and Operative Surgery on the Cadaver, New Orleans Polyclinic; Surgeon to Charity Hospital; Consulting Surgeon to Eye, Ear, Nose, and Throat Hospital.

1885. Park, Roswell, A.M., M.D., 510 Delaware Avenue, Buffalo, N. Y. Professor of Surgery in the Medical Department of the University of Buffalo; Surgeon to the Buffalo General Hospital; Consulting Surgeon to the Fitch Accident Hospital. *President*, 1900; *Vice-President*, 1893; *Member of Council*, 1893–94, 1901–03.

1893. Parmenter, John, M.D., 519 Franklin Street, Buffalo, N. Y. Professor of Anatomy and Clinical Surgery in the Medical Department of the University of Buffalo; Surgeon to the Sisters of Charity, Erie County, Fitch, Children's, and Emergency Hospitals; Assistant Surgeon to the Buffalo General Hospital.

1889. Pilcher, Lewis S., A.M., M.D., LL.D. (Dickinson), 145 Gates Avenue, Brooklyn, N. Y. Professor of Clinical Surgery in the Post-Graduate Medical School, New York; Surgeon to

ELECTED

the Methodist Episcopal Hospital, New York. *Vice-President*, 1893.

1904. Porter, Charles Allen, A.M., M.D., 254 Beacon Street, Boston, Mass. Assistant Surgeon to the Massachusetts General Hospital; Instructor in Surgery, Harvard Medical School.

1887. Porter, Charles Burnham, A.M., M.D. (Harvard), 5 Arlington Street, Boston, Mass. Professor of Clinical Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *Vice-President*, 1892.

1882. Porter, William Gibbs, M.D., 1221 Spruce Street, Philadelphia. Surgeon to the Presbyterian Hospital.

1896. Powers, Charles A., A.M., M.D., Fourteenth and Stout Streets, Denver, Col. Professor of Surgery in the University of Denver, and Surgeon to the Denver City and County Hospital and to St. Luke's Hospital; Consulting Surgeon to the Mercy Hospital and to the State Home for Children. *Vice-President*, 1903.

1886. Ransohoff, Joseph, M.D., F.R.C.S. Eng., 19 West Seventh Street Cincinnati, Ohio. Professor of Anatomy in the Medical College of Ohio; Surgeon to the Cincinnati and the Good Samaritan Hospitals.

1887. Richardson, Maurice Howe, A.B., M.D., 224 Beacon Street, Boston, Mass. Surgeon to the Massachusetts General Hospital; Assistant Professor of Clinical Surgery in Harvard University. *President*, 1902; *Vice-President*, 1897; *Secretary*, 1894–96; *Member of Council*, 1904.

1901. Rixford, Emmet, B.S., M.D., *Vice-President*, 1795 California Street, San Francisco, Cal. Professor of Surgery in Cooper Medical College; Surgeon to City, County, and Lane Hospitals.

1882. Roberts, John B., A.M., M.D., 313 S. 17th Street, Philadelphia. Professor of Anatomy and Surgery in the Philadelphia Polyclinic; Surgeon to the Methodist and Jewish Hospitals. *Vice-President*, 1888 and 1894; *Treasurer*, 1892–93.

1898. Rodman, William L., A.M., M.D., 1904 Chestnut Street, Philadelphia. Professor of the Principles of Surgery and Clinical Professor of the Principles and Practice of Surgery and Clinical Surgery in the Woman's Medical College, Philadelphia; Professor of Surgery, Medico-Chirurgical College, Philadelphia.

1882. Rushmore, John Dikeman, M.D., 129 Montague Street, Brooklyn, N. Y. Professor of Surgery in the Long Island College Hospital; Surgeon to the Brooklyn, St. Peter's, and the Eye and Ear Hospitals.

ELECTED

1882. Senn, Nicholas, M.D., Ph.D., LL.D. (Jefferson), 532 Dearborn Avenue, Chicago, Ill. Professor of the Principles of Surgery and Clinical Surgery in Rush Medical College; Surgeon to Presbyterian Hospital; Surgeon-in-Chief to St. Joseph's Hospital. *President*, 1892; *Member of Council*, 1897.

1902. Shepherd, Francis J., M.D., 152 Mansfield Street, Montreal, Canada. Professor of Anatomy and Lecturer on Operative Surgery in McGill University, Montreal; Senior Surgeon to the Montreal General Hospital.

1905. Sherman, Harry M., A.B., A.M., M.D., 2125 Jackson Street, San Francisco, Cal.

1895. Souchon, Edmond, M.D., 2403 St. Charles Avenue, New Orleans, La. Professor of Anatomy and of Clinical Surgery, Tulane University; Surgeon to Charity Hospital; Consulting Surgeon to the Eye, Ear, Nose, and Throat Hospital. *Vice-President*, 1899.

1900. Taylor, William J., M.D., 1825 Pine Street, Philadelphia. Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases, and to St. Agnes' Hospital; Consulting Surgeon to the West Philadelphia Hospital for Women.

1882. Thomson, William, M.D., 1426 Walnut Street, Philadelphia. Emeritus Professor of Ophthalmology in the Jefferson Medical College.

1882. Tiffany, Louis McLane, A.M. (Cantab.), M.D., 831 Park Avenue, Baltimore, Md. *President*, 1895; *Member of Council*, 1885–89, and 1896–97.

1882. Vander Veer, Albert, A.M., M.D., Ph.D., 28 Eagle Street, Albany, N. Y. Dean of Albany Medical College; Professor of Didactic Abdominal Surgery and of Clinical Surgery in the Albany Medical College; Consulting Surgeon to St. Peter's Hospital; Attending Surgeon to the Albany Hospital. *Vice-President*, 1898.

1902. Vaughan, George Tully, M.D., 1718 I Street, Washington, D. C. Professor of Principles and Practice of Surgery, Georgetown University; Professor of Surgery and Genito-Urinary Surgery, Washington Post-Graduate Medical School; Chief Surgeon, Georgetown University Hospital; Surgeon, Emergency Hospital; Consulting Surgeon, Government Hospital for the Insane, Washington, D. C.; Assistant Surgeon-General, U. S. Public Health and Marine Hospital Service.

ELECTED

1891. Walker, Edward W., M.D., 30 Garfield Place, Cincinnati, Ohio. Professor of Surgery, Miami Medical College.

1882. Warren, John Collins, M.D., LL.D. (Jefferson), Hon. F.R.C.S. Eng., 58 Beacon Street, Boston, Mass. Professor of Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. *President*, 1896; *Vice-President*, 1890; *Member of Council*, 1897.

1896. Watson, Francis Sedgwick, A.B., M.D., 92 Marlborough Street, Boston. Surgeon to the Boston City Hospital; Instructor in Genito-Urinary Surgery, Harvard Medical School.

1889. Weeks, Stephen H., M.D., 662 Congress Street, Portland, Maine. Professor of Surgery in the Medical School of Maine; Surgeon to Maine General Hospital. *Vice-President*, 1903; *Member of Council*, 1893.

1889. Weir, Robert F., A.M., M.D., Hon. F.R.C.S. Eng., Cor. Mem. Surg. Soc., Paris, 11 East Fifty-fourth Street, New York. Professor of Surgery in the College of Physicians and Surgeons, Columbia University; Surgeon to the Roosevelt Hospital. *President*, 1899. *Member of Council*, 1893–1896, 1901–03.

1892. Wharton, Henry R., A.M., M.D., 1725 Spruce Street, Philadelphia. Surgeon to the Presbyterian, Children's, and Methodist Hospitals.

1882. White, J. William, M.D., Ph.D., 1810 South Rittenhouse Square, Philadelphia. John Rhea Barton Professor of Surgery in the University of Pennsylvania.

1882. Willard, De Forest, A.M., M.D. (Univ. of Pa.), Ph.D., 1818 Chestnut Street, Philadelphia. Professor of Orthopedic Surgery in the University of Pennsylvania; Surgeon to the Presbyterian Hospital; Consulting Surgeon to the Germantown Hospital; the Atlantic City Hospital; Jewish Hospital; the Phœnixville Hospital; and the South Mountain Hospital. *President*, 1901; *Recorder*, 1893–1900; *Member of Council*, 1901–04.

1901. Woolsey, George, M.D., 117 East Thirty-sixth Street, New York City. Professor of Anatomy and Clinical Surgery, Cornell University; Surgeon to Bellevue Hospital; Associate Surgeon to the Presbyterian Hospital.

## HONORARY FELLOWS.

ELECTED

1885. ANNANDALE, THOMAS, M.R.C.S. Eng., M.D. Edin., 34 Charlotte Square, Edinburgh, Scotland. Regius Professor of Clinical Surgery in the University of Edinburgh.

1905 BILLINGS, JOHN S., M.D., 40 Lafayette Place, New York, N.Y

1894. VON BERGMANN, SR., EXCELLENZ, HERR NIRKL, Geh. Med. Rath., Klin. Institut für Chirurgie, Berlin, Germany.

1891. BRYANT, THOMAS, ESQ., F.R.C.S. Eng., 65 Grosvenor Place, Grosvenor Square, W., London.

1891. CHIENE, JOHN, F.R.C.S. Edin., M.D. Edin., 26 Charlotte Square, Edinburgh, Scotland. Professor of Surgery in the University of Edinburgh.

1885. CZERNY, PROF. DR. VINCENT, 25 Sophien Strasse, Heidelberg, Germany. Professor of Surgery in the University of Heidelberg.

1885. VON ESMARCH, NIRKL, PROF. DR. FRIEDRICH, 2 Hospitalberg, Kiel, Schleswig-Holstein, Germany. Professor of Surgery in the University of Kiel.

1891. HARRISON, REGINALD, ESQ., F.R.C.S. Eng., 6 Lower Berkeley Street, Portman Square, W., London.

1890. HORSLEY, SIR VICTOR ALEXANDER HADEN, F.R.C.S. Eng., 25 Cavendish Square, W., London.

1894. KOCHER, PROF. DR. THEODOR, Professor of Surgery, University of Berne, 25 Villette, Berne, Switzerland.

1885. LISTER, LORD JOSEPH, F.R.C.S. Eng., D.C.L., LL.D., 12 Park Crescent, London, N. W. Professor of Clinical Surgery in King's College.

1894. MACEWEN, SIR WILLIAM, M.D., Mast. Surg., 3 Woodside Crescent, Glasgow, Scotland.

ELECTED

1903 Robson, A. W. Mayo, M.D., F.R.C.S., D.Sc., 8 Park Crescent, Portland Place, London, W., England. Vice-President, Royal College of Surgeons of England; Hunterian Professor of Surgery and Pathology.

1882. Smith, Stephen, A.M., M.D., LL.D., 574 Madison Avenue, New York. Professor of Clinical Surgery in the University Medical College of New York; Surgeon to the Bellevue and the St. Vincent's Hospitals. *Vice-President*, 1890.

1896. Terrier, Dr. Felix, 11 Rue de Solférino, Paris, France. Professor of Operative Surgery in the Faculty of Medicine of Paris; Surgeon to the Hôpital Bichat.

## REPORT OF THE COMMITTEE ON NECROLOGY.

### JAMES McFADDEN GASTON, M.D.

James McFadden Gaston was born December 27, 1824, near Chester, S. C. He attended the common schools of his native county, and when sixteen years of age entered the South Carolina College at Columbia, receiving his A. B. Degree in December, 1843. The same year he commenced the study of medicine at his home in Chester under his father, Dr. John B. Gaston. He attended one course of medical lectures at the University of Pennsylvania and one course at the Medical College of South Carolina, receiving his M. D. Degree March 6, 1846. He practised at Chester in partnership with his father for six years, removing to Columbia, S. C., the fall of 1852. At the beginning of the Civil War Dr. Gaston was appointed Chief Surgeon of the South Carolina troops under Brigadier-General M. L. Bonham. He accompanied the troops to Virginia, and at Manassas was assigned as medical director under Brigadier-General Beauregard. After the first battle of Manassas Dr. Gaston was transferred by General Beauregard to the Third Brigade, South Carolina Volunteers, under Brigadier-General R. H. Anderson, and, when that officer was appointed major-general, Dr. Gaston was promoted to be chief surgeon of his division. He was sent to establish a general hospital at Fort Gaines, Georgia, and was subsequently in charge of the hospital at Fort Valley, where he remained until the close of hostilities.

Soon after the war Dr. Gaston removed to Brazil and attended the lectures of the Imperial Academy of Medicine. In 1873 he was offered the position of consulting surgeon of the military medical staff of Brazil; this he declined. In 1874, after several years of practice in interior towns, Dr. Gaston went to Campinas, Brazil, and practised there until 1883, when he returned to the United States and took up his residence in Atlanta, Ga. The same year he opened a surgical infirmary in that city. In 1884 he was elected Professor of the Principals of Surgery in the Southern Medical College.

He married, in November, 1852, Miss Sue G. Brumby, of Columbia, S. C., by which union there were ten children. Five daughters and one son, Dr. J. McFadden Gaston, Jr., survive.

Dr. Gaston's priority in the use of elastic ligatures for visceral anas-

tomosis has been established by the editorial of the *International Journal of Surgery*, June, 1904. Dr. Gaston was a member of the following associations: American Medical (Chairman of its Surgical Section in 1891–2); of the Southern Surgical and Gynecological Association (President in 1892); of the American Academy of Medicine (President in 1895); of the Medical Association of Georgia, and of the American Surgical Association.

Dr. Gaston died at Atlanta, November 17, 1903. His death was a great loss to the people and profession.

## KARL GUSSENBAUER, M.D.

In June, 1903, there died one of our foreign associates, Karl Gussenbauer, whose loss was felt most keenly where he was best known, but also in America, especially by those Americans who had worked under him. He was born October 30, 1842, of good family, although his parents were in very reduced circumstances, and his early education was gained with no small difficulty and at no small parental sacrifice. His early training was for the priesthood, for which, however, he soon found himself unfitted. After completing his gymnasium studies he went to Vienna, in 1861, where he became tutor, and, while working in this private capacity, began the study of medicine. At this time his means rarely permitted him more than two meals a day, and these usually of the simplest description; but with indefatigable energy he pursued his medical studies under such men as Brücke, Rokitansky, Hyrtl, and Schuh, and gained his Degree of Doctor of Medicine in 1867. He had aspired to become attached to the Surgical Clinic of Dumreicher, but the latter's absence resulted in his coming under Billroth's notice, who soon recognized his abilities, and enlisted him in his own clinic, in which he soon became, first, private assistant, and then, in 1872, clinical assistant.

He held this position with Billroth until the spring of 1875, when he received a call to the Chair of Surgery in Liege, Belgium. He at once began the study of French, and by the latter part of the year, when he assumed the position, he was lecturing and giving clinical instruction in faultless French. Although a young man, he rapidly made a commanding place for himself in this position, and became the idol of the students. He remained here a little less than three years, when he was called to Prag to take the place of the lamented Heine.

Here he remained sixteen years, the most brilliant period of his life—years which were full of work—where he made a reputation which subsequently secured his call to the chair occupied by his first great teacher, Billroth. It was in Prag that the writer first came under his influence and acquired for him a respect and personal esteem which time can never lessen. While here he declined a call to Würzburg, where he was invited to become Bergmann's successor. In 1886 he was the rector of the German University at Prag. In 1894 he was elected President of the German Congress of Surgeons, the first time that this honor had fallen outside of Germany proper. During this same year he was called to Vienna to take Billroth's place. The writer happens to know that this call was accompanied by a pledge to build for him a

new clinic, to take the place of the very shabby quarters occupied by his great predecessor. This pledge, however, was not fulfilled during his lifetime. Since his death the authorities have determined to substitute a magnificent series of new buildings for the old Krankenhaus, which has been the scene of labors of so many distinguished men. Work was Gussenbauer's motto and principle, and he never spared himself, not even after he had become acquainted with the fact that he had a serious heart lesion. Thus it happened that on June 13, 1903, he was attacked with his first apoplectic stroke, followed three days later by another, which resulted in his death on the 19th of June.

To the writer's mind Gussenbauer was one of the greatest and most distinguished in a brilliant galaxy of German surgeons. Whether as anatomist, pathologist, or operating surgeon, he was excelled by no one in the writer's personal acquaintance. His clinical lectures were models of simplicity of comprehension. As a diagnostician he was unexcelled. His speech, like his writing, was always direct and to the point, and free from that useless verbiage which has befogged the descriptions and writings of many of his compatriots. In his personal and domestic relations he was an ideal parent and friend. His death was a great loss to continental surgery. R. P.

JOHN PETER METTAUER, M.D., A.M., LL.D.

# ADDRESS OF THE PRESIDENT.

By GEORGE BEN JOHNSTON, M.D.,
RICHMOND, VA.

GENTLEMEN: Your magnanimity and generosity have never been more conspicuously displayed than on this occasion, when you have chosen the humblest of your group to stand in the most exalted position within the gift of the American profession.

Your wisdom may be questioned, but your generosity and forbearance are so certain that I enter on the discharge of my duties in full confidence of your kindly treatment and indulgent support. It is hardly too much to say that the highest ambition that a man could nurture might well be satisfied with such fulfilment which confers by your partial kindness the foremost official position in the highest profession of the greatest nation in the world.

One of the gravest and most distinguished of historians opens one of his greatest books with the inquiry whether he is about to do any worthy work or not. Such doubt must assail everyone at the threshold of every task, but the biographer and the historian are at least more nearly removed from its influence than any other man.

In all directions of scientific inquiry the startling discovery of to-day is the truism of to-morrow, and the hand-book of one generation is the curio of the next. In literature, in which it is the main design to entertain, the general taste is so sudden and sure in its changes that hardly anything can be more certain than the passing away from favor of school after school of novelist and poet.

On the other hand, the work of the biographer or the historian is of perennial interest; and this is true for a double reason. The

real theme of these writers, whether it be made obtrusive or not, is the changeless one of human nature. This theme is presented, not as the writer of fiction or poetry presents it, colored with the tints of his own imagination, pleasing, indeed, to many through many years, perhaps, but doomed at last, save those few gems of art which genius has enrayed with everlasting life. The theme of human nature is put on the canvas by the biographer in the staring black and white of simple truth, and interest in his work is no matter of the taste of an age, but is part of the undying desire of men to know of other men. Not to the generation alone is the interest of biography perennial; it is found in a certain large proportion of the individuals of every time. In our callow and romantic youth he who can weave the unsubstantial figment of our dreams in splendid pictures of tournament and triumph is the favorite over all; a little later and the languorous cadence of an Anacreontic falls pleasantest upon an ear tuned for the first time to a woman's tones; and poetry and romance come to be the literary pleasures of our youth. Later, and we are prone to turn to books of the practical sciences, when, in the strength and vigor of our mature manhood, we yearn to do some signal service to the world, and choose politics or sociology or physics for our field. But after all the time of chatty age creeps slowly on, and then no writing pleases but biography. To know what the king said and what the Russian ambassador ate for supper; why the signature to some treaty was delayed or some gentleman missed his garter; this gets to be for us the *raison d'etre* of literature, and we have finally arrived—arrived at our ultimate literary goal. It is by this time plain to you that I purpose departing from the usual custom of discussing a technical theme on this occasion, and, following the example of my immediate distinguished predecessor, I shall present to you a name little known to recent fame, that of one of the builders of that foundation which has made the present superstructure of medicine a possibility; a character so unique, picturesque, and masterful that, if this presentation fail to please and interest you—*mihi defectus*—the fault is mine, and not my subject's.

Among the gallant Frenchmen who followed the fortunes of Lafayette were two brothers, Mettauer, surgeons.

After the battle of Yorktown the French Army was quartered at different points in Virginia. A regiment was sent to Prince Edward County, and attached to this were the surgeons, Mettauer. When the soldiers set out for home, Francis Joseph Mettauer, by the persuasion of General Lawson, the Randolphs, and the Henrys, remained in Prince Edward County, and, later, married there. A son, John Peter Mettauer, was born to him and Eliza Gaulding in 1787.

But little is known of his childhood and youth, beyond the fact that, raised in an atmosphere of surgery, he imbibed a love for this profession, and early determined to adopt it as his life's work.

In the silence of history we are surely justified by the event in assuming that the child inherited from an adventurous and accomplished sire much of his cast of mind, and that an hereditary disposition toward surgery was, in those early days when the modern practice was certainly no more than embryonic, vastly aided by that same tendency toward aggressive self-reliance, which brought the elder Mettauer to our shores as a surgical soldier of fortune.

Young Mettauer was sent to the neighboring college of Hampden-Sidney for his literary studies, and graduated from this institution with the degree of A.B. in 1806. He immediately entered on the study of medicine, and received the degree of M.D. from the University of Pennsylvania in 1809.

Mettauer's medical education was carried on under the most favorable conditions obtainable in America at that time. The medical department of the University of Pennsylvania, founded in 1791, was the continuation of the first medical school in this country, which had evolved, in 1765, from the lectures on anatomy and midwifery by William Shippen, Jr., an ardent admirer and former student of John Hunter. Mettauer entered his medical course in the same winter that brought the death of Shippen, and he always took a "mournful pride" in having heard the last lecture of that great pioneer teacher. The influence of the character and

methods of Hunter were continued in the University by Physick, another exponent and close follower of that great anatomist and surgeon. This influence (doubtless of weight in Mettauer's entire career) may most readily be traced through all his subsequent writings in the clear, concise descriptions of anatomical and pathological relations and his tendency to the objective methods of study, which were so rare at that time, when only a few pillars had been placed for the foundation of the accurate scientific medicine of to-day. For nine years Physick had been lecturing at the University on surgery, and for four years had been professor of surgery. Mettauer was under him at the choicest period of his career, when he had won for himself the reputation of the leading surgeon in America, and had not as yet allowed the worries and depression consequent upon an exhausting practice and failing health to dim the ardor and brilliancy of his surgical achievements. From Physick's teaching Mettauer caught the enthusiasm for the lateral method of lithotomy, in which he afterward became so wonderfully dextrous and laid the basis of his great skill in other branches of genitourinary and orthopedic surgery. Perhaps the inspiration may be traced also in some of his great plastic devices.

The influence of Rush also had necessarily its permanent effect on a mind so receptive and able as Mettauer's, and he carried from his courses that inspiring love and devotion to science and search for truth which lighted dark days of arduous practice in Virginia, and upheld him in the determination which he afterward voiced. "Though doomed to labor in the country as a practitioner, I resolved to continue my studious habits and, if possible, not to fall behind the daily improvements of the profession." His methods of general treatment in certain inflammatory conditions follow closely those so prominently exploited by Rush, along with whom Mettauer pinned undying faith to all antiphlogistic measures, but particularly calomel and bleeding.

In the treatment of the continued fevers, however, Mettauer (apparently on the strength of his information based on personal experience) departed from the drastic measures of Rush, whose enthusiastic description of calomel as the "Sampson of medicine"

had been sarcastically approved by his opponents on the ground that it had killed its thousands. Mettauer advises, in an essay of 1836 on "Continued Fevers," "when the temperature is painfully elevated the surface should be sponged with cool or cold fluids, and, if desired, the patient may take pounded ice, or iced or cold water, into the stomach," and purgatives were to be used only at the beginning of an attack, or in special cases of continued constipation, a course of treatment in close accord with our modern ideas, and a considerable advance over the early methods of the last century. Further, Mettauer read with avidity and intensity the volumes in the library of the Pennsylvania Hospital, the oldest medical library in America; and we find his writings containing many references to the great Louis, who had taken the principal part in forming this collection.

Besides this, Mettauer was having extended practice in the Philadelphia Dispensary during his stay in that city, and had additional opportunities for practice through the kindness of several of the attending physicians, who apparently had taken a great fancy to the industrious Virginian. This is clearly shown by an incident which Mettauer records himself with just pride. "On a certain day, as I chanced to be on Market Street, Dr. Wistar, who happened to be on the opposite side, crossed over, seemingly to meet me; after grasping my hands with his own, he thus accosted me: 'Dr. Mettauer, my young friend, I am happy to meet you and to congratulate you on your examination, which, I take pleasure in informing you, was entirely satisfactory to the professors and agreeable to the University. You have the means in your hands for success in your profession. Continue your studious habits and nothing but bad health or early death can disappoint you;' and such a meeting and salutation from such a man as Dr. Wistar completely overpowered me, and my tears had to express the emotion of my heart in response." It was thus with a very rare equipment of scholastic and medical learning that Mettauer found himself launched with honor into his life work.

"Omnibus," it is said, "est compensatio," and every circumstance has some alleviation. In the subject of the difficulties which sur-

rounded the earlier practisers of any art, there is, at least, one compensation of which we are likely to lose sight—the speed with which recognition and celebrity come to the worthiest. It is hardly possible in our day in medicine that any man should go out fresh from the greatest college and wake to fame. With few exceptions, our own experience assures us of the length and roughness of the way that lies from Alma Mater's portals up the hill, and fame and fortune are confused in the bestowal of their signal favors by the thronging multitude of them that sue.

Not thus a hundred years ago. When young Mettauer came home and began the enthusiastic practice of his profession, he became conspicuous at once. It may be that he was aided by the lucky star; one of those which shine occasionally now on the young doctor, that guided him to a patient who, even in the most favorable circumstances, declined to die, and that the beginning of his fame rests on no deserts of his. However this may be, famous he almost at once became, and soon proved himself worthy the place that he had gained, and as he grew in age, made ever to his death higher and higher advancement in the reverence of the people, and in the estimation of his professional brethern.

Beginning his practice in much the same circumstances as most young men of his time, he was at first differentiated, mainly by the two outward marks that he went his rounds in a carriage instead of on horseback, and that he wore, certainly at his meals, and even to bed for aught that is known to the contrary, an enormously tall stovepipe hat. His work consisted at first, of course, in the practice of general medicine, with such cases of surgery as were afforded by a large community to an enthusiastic and tireless worker in this field. Gradually, Dr. Mettauer's preference for surgical work and his skill—marvellous for his day, and well-nigh marvellous for any day—began to bring him cases from a distance; and his reputation, growing as his fame, was spread in widening circles on the sea of human misery; these cases became so numerous as to occupy most of his time and to enable him to follow the bent of his genius and devote himself almost exclusively to surgical work. Patients came to him from an area that ever

increased; from the most distant parts of the United States and in some instances from abroad. Step after step the quiet country home took on the aspect of the hospital, and the whole neighborhood became permeated with interest that grew out of the accomplishments of a single man.

This is, perhaps, as proper a place as any to make some reference to the almost incredible amount of surgical work that Mettauer accomplished. Persons now living who remember the circumstances, and had more than common opportunity to know whereof they speak, have told me that for a period of about forty years the number of surgical patients who gathered to Mettauer for treatment was sufficient to keep him constantly with from 45 to 60 cases under his care. Often it was true that about every good house in the community sheltered some person who was convalescing or awaiting his turn for operation. I have heard his operations for cataract put in number far beyond the 800 that can be accounted for: Dudley's great record in "cutting for stone" 225 times in a practice of forty years must yield to Mettauer's total of 400 operations, and the number of strictures relieved is commonly put at something over 200. Three operations are recalled, performed in the last week of his life, when, at the age of eighty-eight years, his eyes were yet keen enough and his hands steady enough for him to make a successful operation for cataract, for stone, and for amputation of the breast.

Writers of renown have given us the picture of the placid rural life in old Virginia, and it is no part of my task to attempt a description of the conditions and manners of the people there a hundred years ago. It must suffice for my purpose to say that Mettauer's native country was a typical part of the old South, in which but two classes, the highest and the lowest, the master and the slave, played an important part. Of the middling sort of folk—the yeomen—the civilization needed few, and to them were relegated such employments as were beyond the condition of the slave, and beneath the dignity of the gentlemen—such employment as conducting shops and the small mills and stores throughout the countryside. Into Prince Edward Court House,

a representative old-time village, poured an ever-increasing stream of patients, who sought the services of Mettauer. From the necessity of the case, the greater part of those who came from a distance were people of consequence, and in many instances they travelled in their own carriages and with their own retinue of personal attendants, and formed at times a crowd sufficient to try to the utmost such modest accommodations as were afforded by the doctor's private hospital, and by the two houses of entertainment at Kingsville and Worsham, referred to in the phrase of that day as commodious taverns. Had Dr. Mettauer possessed an eye single to the main chance which has degraded the skill of some of our brethren, the dreams of avarice could scarcely set a limit to the wealth he might have amassed. An occasional story of a considerable fee is met with, but commonly there are circumstances of the patient's reputation for wealth and parsimony which might warrant the suspicion that the uncommon size of Mettauer's account was rather a piece of humor—sometimes pretty grim to the second party —than anything else. In this direction is the story of Mr. ———, who, with a number of new one-hundred-dollar notes held conspicuously in his hand, dropped into the office to settle his account. He handed a note to the doctor, who, to his surprise, did not pocket it, but still held out a hand, into which, after a moment's delay, another note was placed, and then, with a moment of embarrassing silence, another, and then, when the silence grew to be eloquent, another. Four hundred was clearly the limit to which the visitor could be got by silence, however eloquent, or by embarrassment, however deep, and still Mettauer held out his hand. At last he gently suggested, "One more, if you please, Mr. ———," and the gentleman, half hypnotized, deposited his last note.

Mettauer appears, however, to have placed no value on money, except as a means of carrying on his work, and an exterior a little repellant concealed a heart as great and warm as ever throbbed in human breast. A vast deal of his time was given to practice, whence he could hope for neither fortune nor fame, and this not spasmodically, but regularly and for years.

Again, the course of his work at home was interrupted, particularly very early in his career and late, when he could leave in the hands of his highly accomplished sons the interests of his local patients, and Dr. Mettauer would undertake journeys of weeks for the relief of persons who were unable to come to him. A drive from Prince Edward down into Georgia was about the most considerable of these undertakings, and we should be likely to agree, if confronted by a similar proposition, that it was quite considerable enough. It is hardly possible that less than two months was consumed in this expedition, and it is a matter of legend that the fee which Mettauer received—one thousand dollars—was regarded to be stupendous. There are no means of mapping out the trip into Georgia, but there is some reason to assume that the doctor combined with his main object several calls which he was desirous to make somewhat along his route. But, even with a considerable allowance for combinations, such a trip as this was a great sacrifice of time and strength, and it makes one of the records that shed on Mettauer's career that kindly light in which we recognize the genuine enthusiast and the self-forgetful man of science.

With a great practice then, and with an ever-increasing fame, Mettauer began to feel the need of systematizing one of the activities which, in his day, was part of the work of almost every celebrated physician. So large had become the number of promising young men who were attracted to read with Mettauer that there was no hope of giving them, as individuals, the assistance which they needed, and Dr. Mettauer gradually introduced more and more system into his intercourse with these young men until, in 1837, his group of private students was organized into a medical institute, which later became part of Randolph-Macon College. This medical school was never large in numbers, as Mettauer did not design it as a rival to any of the great schools then in existence. His pupils were generally from Virginia, and drawn in large part from circles in which Mettauer's work was well known. These young men numbered among them no small proportion, who later attained high reputation in their profession; and this

could hardly fail to be the case when one considers the quiet and freedom from distraction in which their studies were pursued, the zealous and enthusiastic spirit of their chief preceptor, and the constant spur to their laudable ambition, which lay in the close and not too-often interrupted intercourse with Mettauer.

The doctor found these young men ardent and tireless aids in his work. Under his direction they constructed many of the necessary instruments; he himself was a mechanic of rare ingenuity, and old Peter Porter's shop in Farmville was the scene of many an important conclave from which was born no inconsiderable number of devices that to-day form part and parcel of the instrument and implement maker's stock. In my possession are not a few of these old tools of the early days of our craft—some of iron and some of silver, some made by the doctor himself, and others constructed according to his drawings by an old negro, now living in Prince Edward, who, before the war, was a cunning artificer in gold and silver.

These young men formed also a corps of nurses and assistants, such as is rarely found, and there is no question that the doctor's students rendered to his hospital work quite an equivalent for the excellent training which they got from it, even though this included that highest desideratum—the bedside clinic—to an extent which no school ever surpassed. Of course, it goes without saying that these enterprising young gentlemen never suffered the dissecting table to want a subject, and not a few of the stories of Southside Virginia which have now grown part of the negro folk-lore of the region, may be traceable to the midnight maraudings of this band.

The medical school reached and sustained an enrolment of thirty or thirty-five students. As Dr. Mettauer was a most voluminous writer, he was also very methodical and careful in literary matters, and there exists quite a large amount of his MS., in which is the opening address delivered in 1837, when he had injected enough of regularity into his intercourse with his private pupils to make the title of "Institute" appropriate. This opening address is sincere and dignified in its modest tone, and might well serve

as a perfect model of propriety when one considers all the circumstances in which it was delivered. The speaker pleads the paucity of medical schools in the United States—there were but twelve in all—and particularly in the South, which had but three, and derives no inconsiderable part of them from just such beginning as he himself had made: the growing number of men who in past years had grouped themselves as private pupils about some physician whose success in practice had gradually forced him into the position of preceptor.

With steady and excellent results the Medical Institute was kept up until, in 1848, it became the Medical Department of Randolph-Macon College, and the "announcement" of the school under the new auspices contains the names of three Mettauers as faculty. This same announcement makes reference to graduation charges, etc.; but it is not sure that any physician went at once to his practice from the tuition of his school, though I have been able to obtain one of its early diplomas—that of the late Dr. Oscar Wiley, of Salem, Va.—a now distinguished physician and an ex-president of the Medical Society of Virginia. The session was ten months long, and credit was given by the distinguished schools of medicine for time spent in this institute. The Jefferson School, the University of New York, and that of Louisville were among the colleges which admitted Mettauer's students on the *ad eundem* footing, and there were probably others.

An outgrowth of Dr. Mettauer's literary instincts, and a most valuable one, was the stress put on essay work in his classes. "Memoirs," as he preferred to call them, were liberally demanded on proper occasions, and were without doubt the means of clarifying much that was otherwise misty to the student mind.

The formality and dignity of the work done in Mettauer's Institute were as great as could be found anywhere. The universal consent of all the old students of the school who have left behind any record of their impressions and the declaration of the distinguished men, pupils of Mettauer, who are yet among us, all force the conclusion that in no important regard was the work of his institute inferior to the highest models. Pages might be filled with

quotations from letters, addresses, and magazine articles exhibiting the appreciation in which his teaching work was held by his contemporaries, and forcing the conclusion that, had the environment of the institute been less unfavorable, it might easily have become one of the great permanent medical schools of the land.

There is no obtainable record of the formal closing of Dr. Mettauer's Institute. So far as is known, it continued to be part of Randolph-Macon College until the suspension of that school, and naturally terminated by that event; it was never opened again.

Returning to the consideration of Mettauer personally, I would remark that all the contemporary evidence agrees that he was of phenomenal skill and daring as a surgeon. His one peculiarity in operations seems to have been an invincible objection to watching any other man at work, and this peculiarity carried him to the extent of refusing assistance even in a long and exhausting case. The reason probably lay partly in his nervous need to keep occupied in order to distract his attention from the patient's suffering, which in the preanæsthetic days must have been a serious trial to the sympathetic surgeon; and it is likely that Mettauer was moved also by the need for haste and the knowledge of what unerring and lightning skill lay in his supple hands.

No characterization of Mettauer could be complete unless it took note of the practical common-sense which guided him in his work whenever there was no other guide to be found in his own experience or in that of other men. In employing the methods suggested in the most advanced journals he was by no means sure to follow even remotely the details of an operation. An instinct enabled him to grasp the essential of the matter, and, this accomplished, he was rather more likely to improve and to shorten the details than to follow in the track laid down by him who first described some new method. In exactly the same direction it mattered not seriously to Mettauer whether he had an instrument of the make of the most celebrated shops or of his own fashioning, or none at all. To turn any sort of thing into a reasonably sufficient tool was a common trick of his, and hence we read of emergency catheters made out of pipe-stems and of every sort of em-

ployment of the commoner articles of daily use to serve some professional turn.

When one calls an American country surgeon of the old day "daring," he has in mind no trace of the fussy, vain desire for notoriety, which we sometimes now associate with the advertising surgeon, and which some writers have pretended to discover among some of the surgeons of France. Surgical daring is a matter of the *when*, not of the *what*. The ancient poet gives oak and triple brass about the breast to him who first trusted his frail bark to the savage deep, and now the trackless highways of the ocean are safe as highways of the land. In the sense that he was far ahead of his age, and only in that sense, was Dr. Mettauer a daring surgeon. Many of his operations would stamp him as a high leader in surgical advance, and on several of these the fame of an ordinary or even an ordinarily great man might securely rest. But Mettauer's most brilliant work in the way of operations was his method with vesicovaginal fistula, and his successful employment of wire sutures made of lead, in which he antedated by a good many years even Sims, whose name is generally associated with this operation. So successful was Mettauer that he declared his belief that every case of this sort was curable by his method, and, so far as his efforts were reported, I am not aware that he ever failed in one. Proper pride and regard for his own reputation in the coming years must make every surgeon careful to a degree in assigning credit for useful and honorable achievements to those who have preceded him, and there is in the history of surgery no claim more clear and unmistakable than that of John Peter Mettauer to the honor of discovery in this case, and he is plainly entitled to rank in medical history and in the grateful memory of his successors in the same class with McDowell and Dudley and Sims and Mott.

Strangely enough, Mettauer's isolated position and his little conspicuous way of life have barred him from well-earned fame, and he is not even mentioned in some such works as Mumford's *Narrative of Medicine* and Park's *History*. Even where it would appear that circumstances demanded a thorough knowl-

edge of Mettauer and of his work, the reference to him is so slight as to be slighting. In 1858 Sims takes occasion to rebuke an old associate of his for the attempt to defraud him of the credit of the use of silver sutures in vesicovaginal fistula. His reference to Mettauer, even in these circumstances, is so slight that at first reading I overlooked it. He says in part, "In 1845 I conceived the idea of curing vesicovaginal fistula," etc. Mettauer's first reference to the matter appeared in the *Boston Medical and Surgical Journal*, vol. xxii. p. 154, *twelve years* before Sims' communication, and it clearly outlines the operation which ought always to be associated with his name. In the *American Journal of the Medical Sciences*, new series, vol. xiv. p. 117, *five years* before Sims' communication, Mettauer says, "I am decidedly of the opinion that every case of vesicovaginal fistula can be cured, and my success justifies the statement." It seems almost marvellous that so little should be known of Mettauer, when we go on to say that his was clearly the earliest operation for cleft palate performed in the Western world (he used for the work a novel instrument made for the purpose by himself), and that he was clearly among the first of American surgeons in adopting or adapting the best of the advance suggested by any other man. He was, also, the original suggester of the employment of iodine in the treatment of scrofula, and among the first in such major operations as amputation of the shoulder, ligation of the carotid, and resection of the superior maxilla. And last, but not least, it is by no means sure that, in the care and detail of his preparations, he may not be ranked as the American Lister, and it is certain that the excellence of his precaution seems almost, by a sort of invested inheritance, to have come to him from some advanced man of our day.

Dr. Mettauer was a man of striking appearance; tall, well-formed, and robust; his piercing black eyes were shadowed by a heavy fringe of brow, and above arose a forehead high and of the most intellectual shape. He was seclusive in his habits, and few persons were admitted to any closeness of acquaintance, and very few to any sort of intimacy. In fact, from the first dawn of manhood to his death he was busy. His practice with the patients who

came to him in his office at home and that at Farmville, where he was to be found at certain hours every day, would have appalled the average worker; his medical school was, in the language of our streets, a good deal more than one man's job, and, in addition, he did an amount of writing which would have kept the ordinary scientific man engaged all of his time, and satisfied him wholly with himself. To this eternal business may be attributed much of Mettauer's failure in the social duties, and it is vain to inquire whether, in other circumstances, he might have been more approachable. That he was master of some, at least, of the social charms is witnessed by the fact that he was four times married, and in each instance to a woman of attraction and excellent social connections.

To an extent, which never failed to make his character of interest, but which never subjected him to ridicule, Mettauer was eccentric. There was, indeed, about him that which would have saved him from ridicule, even had he been far more eccentric than he was. I have referred to his invariable custom of wearing on all occasions and at all times a preposterously tall hat. One of his children, now surviving, has told me that she never saw her father without his hat on. He never attended service in the churches, and the explanation was always assumed to lie in the unwillingness either to remove the covering from his head, or to attend church wearing his hat. He would decline to take off his hat in court on the occasions when his expert testimony was sought; and the sole occasion on which a judge seems to have insisted that the doctor should be uncovered brought from Mettauer the suggestion that if his evidence were essential to the case he would be pleased to give it with his hat on, and that if it were not so, he would be quite as well pleased to leave the court-room, meanwhile, of course, wearing his hat. With posthumous insistence, Dr. Mettauer left directions that he should be buried with his hat on, and a coffin a trifle over eight feet long was found necessary to contain his body with this favorite article of dress and the considerable number of instruments which, along with a parcel of letters from his first wife, he directed to be buried with him.

It is really not likely that Mettauer's absence from religious and social gatherings should be put down to oddity. There is far more probability that the same lack of time for anything other than the tasks he set himself, which marked him out as a man without a pastime, also prevented his attendance on any occasion where his professional service was not in demand.

Dr. Mettauer formed for the community in which he was born an affection which was little short of passion. He had numerous opportunities to come out into the great world under the fairest auspices, but he found when he tried it that he dragged a lengthening chain wherever he roamed that anchored him back in Prince Edward again. He once made a settlement, which proved a brief one, in Norfolk. He tried life in Baltimore as professor of surgery in Washington University, but soon the longing for his native scenes swept over him, and he came home to stay.

Mettauer's versatility was so truly great that he might have resented an intimation which identified him with any particular branch of practice to the exclusion of the others. Pre-eminent as he was in surgery, he certainly did resent what he considered the invidious attempt of some of his brethren to classify him as a specialist in that direction, and, though he would have scorned a consideration which rested solely on his writings, these were, in magnitude and in force, enough to make the *magnum opus* of another man. I have in my possession a very large number of manuscripts on various medical and even quasi medical topics. These were produced in his most active literary period, from 1825 to 1845. Among them are articles and essays on yellow fever, congestive fever, puerperal fever, Asiatic cholera, continued fever, remitting and intermitting fever, and a most interesting article on the prophylactic use of drastic purging in the early treatment of puerperal fever, etc. During these years he was a most voluminous and valued contributor to nearly every medical journal published in this country, and on my book-shelves are uncounted piles of the older journals containing contributions from Mettauer, to which the editors well-nigh uniformly assign the place of honor in their magazines.

In all respects the most remarkable of his performances along this line is his manuscript work on surgery. It would be endless to attempt to make one appreciate this by giving quotations to show how clear was his analysis and how finely chosen was his phrase. I should almost prefer to attempt to arouse your appreciation by the well-known method of the Dutchman who described Dr. Johnson's "Rasselas." "Dot vas quite a leedle buke," he said; "mein bruder writ a buke more as five times as big." Dr. Mettauer's surgery contains about 3000 pages of manuscript, closely and most clearly written on the old blue legal cap paper of his day. I am glad to say that I have the original, and, I assume, the only draft of this manuscript, and a truly remarkable piece of work it is. I have no means of knowing why the book was never published. It could hardly have been for the lack of money, since Mettauer numbered among his loyal admirers many persons who would probably have been delighted to show appreciation for the benefit conferred by his skill, and to take on themselves the charges necessary to bring the book to light in case the doctor was unable to attempt it at his own expense; and this latter is by no means probable, since Mettauer, from the superabundance that he might have gathered in, appears to have had quite money enough at all times for his needs.

The book shows an intimate and enormous knowledge of all the directions that surgery in his time took, and not a little of the choicest fruit of elegant acquaintance with the older literature is scattered here and there throughout the work. The description of tuberculous orchitis is, perhaps, especially striking. He says: "Young persons of strumous constitutions are the chief subjects of this affection, and the epididymis is more frequently the seat of the morbid deposits than the substance of the gland. The adventitious deposit presents the same appearance as in the lungs and lymphatic glands, consisting of small isolated masses rarely larger than a pea or in the form of infiltrations, which, after a time, transmute the testis into a yellowish, curdy, cheese-like substance. The deposition may take place into the cellular tissue of the organ, or in the seminiferous tubules, which most commonly are its

recipients. There is always more or less enlargement, induration, and change in the shape of the testis, and the disease begins insidiously, is painless, free from tenderness under pressure, and often remains stationary for months, or even years in some instances. Finally, however, the scrotum becomes adherent and of a dark hue; the tuberculous matter softens, resulting in abscess, which sooner or later bursts, forming an ill-looking ulcer."

So great is my interest in seeing full justice done to the genius of Mettauer that I am seriously contemplating some extended work in the way of a biography. To this I relegate more detailed mention of his writings, and in it I hope to give some extended and valuable extracts from the surgery.

In 1875, in the month of November, Dr. Mettauer was called to attend a case of morphine poisoning a short distance from his house. He was just about completing his eighty-eighth year, but was alert and erect and as interested in his science as when in manhood's prime. A walk through the snow made his feet wet, and in the urgency of his long-continued and successful struggle to sustain animation in his patient, he neglected his own risk and took a deep cold, which, in the course of a short time, developed into pneumonia, and in two days he was dead. Surely he crowned a useful life with an heroic death. So, when our work is done, might we also well wish to pass away; our final act an act of healing, and meeting death as those who have often overcome him and have no need to fear the time when, in our turn, we shall be overcome.

But a few days ago I stood in an old graveyard, beside the spot where, his triumph and his labors now long past, Mettauer lies buried. One needs not the moralizing strain of Denmark's Prince to reflect, beside that sunken and neglected grave, how swift the waters of oblivion flow. Great as he was—untiring, bold, resourceful, zealous, a prodigy in his age and a prophet of the time to come—he leaves behind no monument more durable than this slight tribute which your courteous attention enables me to pay to the memory of John Peter Mettauer.

# END RESULTS IN SURGERY OF THE KIDNEY, BASED ON A STUDY OF NINETY CASES, WITH ONE HUNDRED AND TWENTY-THREE OPERATIONS.

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This paper is based on a review of about 90 cases of lesions of the kidneys requiring surgical intervention, and occurring in my own practice. I have been able to trace each patient to a fairly correct final result; many cases occurred at a time when the development of renal surgery was progressing along lines of intelligent investigation and safety regarding the various operations called for. The writer is thoroughly cognizant of the early criticisms made in reference to the diagnosis of movable or floating kidney, and final reference to the surgical side for permanent relief. In the years past the marked symptoms associated with this lesion, all of which are at present grouped under the name of Dietl's crises, were formerly explained in some other manner than the true recognition of a kidney lesion; and while I have treated many cases successfully with rest, the abdominal bandage, and kidney pad, yet I am frank to say that I have great respect for the operation of nephrorrhaphy; that it is comparatively safe, and results in radical comfort and permanent relief.

The first group here presented is made up of cases in which there was marked evidence of a movable or floating kidney, four of the latter being very positive, as the kidney could be found and moved to any portion of the abdominal cavity. A number had been intelligently treated medically for periods ranging from three months to a year, yet without relief, and were finally brought

to an operation. There were 23 cases, exclusive of those where an incision of the capsule, for nephralgia, examination for stone, and decapsulation for Bright's disease was done. It is interesting to note that 19 of these occurred in the female, about two-thirds of whom were married, the lesion being on the right side; there were four males, the lesion also occurring on the right side, and the entire number recovering. In a review of this group, I desire to present a few of the most striking cases.

Mrs. B. B., aged fifty-three years, admitted October 23, 1901. Nephrorrhaphy; nephrectomy nearly four years later.

Diagnosis: floating kidney, right side, very marked. Urine: a high specific gravity, trace of albumin and pus, but no casts. Later there were granular and epithelial casts. Usual nephrorrhaphy, patient making a good recovery, continuing, however, to have pus in urine for two years after operation, but since then in good health, able to take long walks, and kidney felt in normal position. April 19, 1905, she suffered from severe attacks of pain in right side, sometimes extending down course of ureter. Urine practically normal at times, then large quantities of pus and epithelial débris, especially following an attack. May 29, 1905, severe attack of renal colic; temperature 104°, and pulse rapid and small, with marked distention of right side, pain radiating toward bladder. Diagnosis made, by her attending physician, Dr. Ward, of pyonephrosis, with obstruction of ureter, probably due to a deposit of mucopus, or, possibly, a renal calculus. Segregation of urine, by Dr. James Vander Veer and myself, revealed the fact that no urine was passed from the right kidney, but discharged freely into tube from left. Nephrectomy advised and performed on June 11, 1905. Kidney found in excellent firm, fixed position, but much enlarged, with small elevations covering cortex, some seemingly cystic to the touch. An abscess, size of an egg, located in pelvis of kidney, was ruptured in pushing aside the perinephritic fat, and a small, cone-shaped calculus found at mouth of the ureter. Exploration of ureter failed to reveal further obstruction, and was tied off low down. Silk used for pedicle and chromicized catgut ligatures for vessels; large,

straight rubber drainage tube inserted. Patient has done nicely since operation. I present the following specimen and pathological report from the Bender Laboratory, made by Dr. Pearce: Anatomical diagnosis: Chronic diffuse nephritis. Reparative changes in capsule of kidney, due to former decapsulation and fixation. Nephrolithiasis. Acute suppurative pyelonephritis. Diffuse hemorrhage of kidney.[1]

Mr. W. F. K., aged twenty-three years, admitted November 29, 1901. Patient had suffered from agonizing attacks of pain in right lumbar region, and urine contained blood.

Nephrorrhaphy; patient made a good recovery, and kidney remained in normal position, the urine improving rapidly, but two months later he had an attack of acute appendicitis, requiring immediate operation. Kidney then found in excellent position, and patient well at present.

Mrs. S. P. O., aged forty years, admitted March 25, 1902. This was rather a remarkable case for diagnosis. The attacks of pain were so high up there was some doubt as to whether it was not gall-bladder trouble, but final diagnosis of floating kidney prevailed, nephrorrhaphy done, diagnosis confirmed, and patient in fine health two years later.

The following is a somewhat remarkable case:

Mrs. H. W., aged twenty-eight years, admitted January 28, 1903. Diagnosis, floating kidney, right side. She presented several pathological conditions. In September, 1902, had had appendix and right ovary removed, but, pain continuing, she was advised to enter the Albany Hospital. Exploratory incision, February 2d, revealed a hypodermic needle penetrating into peritoneal cavity, and removed from right side. Stump of appendix, right ovary and tube in normal condition. Bicornate uterus discovered, and movable kidney, right side.

Nephrorrhaphy February 17, 1903; good recovery, and patient in excellent health two years later.

[1] Histological examination confirms the anatomical diagnosis of chronic diffuse nephritis and acute pyelonephritis, with hemorrhage.

Mrs. M. H., aged thirty-three years, admitted December 28, 1904. Diagnosis, movable kidney, right side. Usual nephrorrhaphy; patient made a good recovery, but May 15, 1905, she presented at my office with all the marked symptoms of cholecystitis, with accompanying intestinal indigestion. She is, however, free from her old distress in right side.

Mr. J. S., aged twenty-six years, admitted February 28, 1905. Diagnosis: movable kidney, right side. Nephrorrhaphy, with good result. Patient passed through typhoid fever after operation, but four months after in excellent condition, and kidney in good position.

Mrs. F. H., aged thirty-one years, admitted March 1, 1905. Nephrorrhaphy, later, appendectomy and cholecystotomy.

Family history negative. Patient has had throat, menstrual, and gastric trouble, also jaundice at times, and given medical treatment at various hospitals, with dilatation and curettage, February, 1903, for excessive menorrhagia, with good result. Later, pain in right side referred to floating kidney; pad applied, but no improvement, and April 1, 1905, nephrorrhaphy done. Kidney found small and very movable. Good result followed this operation, but some three weeks later she suffered from an attack of gastric pain, intermittent in character, and all the symptoms of cholecystitis, associated with symptoms of appendicitis. Operation revealed a catarrhal appendicitis, and a single stone impacted in cystic duct. Patient has made a good recovery from her many ills, although biliary drainage still continues.

The study of abscess of the kidney as a surgical lesion, and the classification under the headings of pyelitis, pyonephrosis, pyonephritis, or ascending pyelonephrosis presents a most impressive view of the subject. With the improved methods of examining the pelvis of the kidney, through the urinary secretions, either by means of cystoscopy, catheterization of the ureter, or segregation of urine, an early diagnosis should be reached, and it is unlikely that the cases marked by large pus collections will present so forcibly to the surgeon in the future as in the past.

Of nephrotomies there is a total of 24, as follows: Male, right

side, 2 recovered; left side, 6 recovered; 1 died. Female, right side, 9 recovered; left side, 6 recovered. Nine of these cases finally required nephrectomy, one of the latter resulting in death. Of the remaining 15 cases all made good recoveries but 2, after a period of four years, 1 having a very slight sinus, not deep, no pus in urine, and patient in excellent health, this being a horseshoe kidney; the other patient yet in ill health from late secondary pelvic abscesses.

The following case of tumor of the prostate and pyonephrosis, right side, with nephrotomy, I think worthy of note:

Mr. E. S. W., aged sixty years, admitted September 19, 1902. Much pain in right side and chronic enlargement of prostate. Catheter employed for past five years, instrument probably not always in an aseptic condition. Patient a very active business man, who for a number of years failed to empty bladder within a reasonable time, until atony was established. On admission to hospital he had severe pain in right side; chills; prostration; high temperature; fluctuating mass in connection with right kidney. Urine foul, very offensive, a great amount of pus, but no casts. Much trouble in passing soft catheter, and silver instrument used. Rectal examination: very large prostate, with possible growth within gland. Washing out bladder afforded some relief, although blood followed at times.

Nephrotomy October 2, 1902, with an escape of a large amount of pus drainage. Patient did fairly well at first, but died on the eleventh day from sepsis.

Autopsy, by Dr. Blumer, showed excellent drainage. Impossible to have removed kidney because of adhesions. Phlebitis of right leg. Everything in an unusually clean condition. Left kidney much enlarged, with many abscesses—a true type of surgical kidney.

I have never seen a larger growth than was connected with the right lobe of the prostate, macroscopically malignant; in left lobe a growth the size of a turkey's egg, but isthmus presented no marked obstruction, probably accounting for the ease with which he passed a catheter. An early operation might have done this man much more good.

Mrs. H. K., aged fifty-eight years, admitted September 28, 1902. Diagnosis, pyonephrosis, right side. Past two years has had attacks of pain and vomiting, since August being confined to bed, with elevated temperature most of the time. Very marked swelling below ribs, in axillary line, tender and fluctuating on palpation.

Usual oblique incision; kidney opened, evacuated of pus, cavity washed out, T-drainage tube inserted, and one piece of iodoform gauze tampon. Patient eventually made a good recovery, with marked improvement in urine immediately following operation, and is now well.

Mr. R. R., aged twenty-six years, admitted April 20, 1903. Diagnosis: cystitis, double pyelitis, pyonephrosis, and surgical kidney, right side.

Patient gave a history of constant, sharp, localized pain in right side, with specific urethritis four months previously; chills and fever, with much pus in urine. Under careful medical treatment, and washing out bladder, patient improved somewhat, but lately there was a great increase of pus in urine, with pain on left side. After consultation with Dr. Macdonald and Dr. Lange, of New York, I made an exploration of right kidney, incising down to the pelvis. Some pus discharged, and small T-drainage tube placed in position. Discharge quite profuse at first, then lessened; pus in urine much smaller in quantity, but left kidney enlarged, with marked tenderness. This condition abated, however; drainage tube removed, sinus healed, and kidney remained in good condition. Patient heard from recently. Has gained in flesh, urine clear, and symptoms abated. Since writing this paper a letter from Mr. R., who is abroad, states that the drainage tract, in connection with the right kidney, had to be reopened, and there was free drainage, but he was doing well otherwise.

Of the cases of nephrectomies by lumbar incision, for pyonephrosis, there were 8, as follows: Male, right side, 2 recovered. Female, right side, 3 recovered; left side, 2 recovered; 1 died.

It is proper to state that these cases did not present so serious a condition as the ones in which it seemed best to do a nephrotomy first.

The following illustrates a few of the cases contained under this heading:

Mrs. M. W., aged thirty-six years, admitted February 3, 1894. Diagnosis: pyonephrosis, left side. Patient in a very serious condition, and immediate operation decided upon. Usual nephrectomy. After operation right kidney continued to secrete a good, fair amount of urine, but patient showed signs of peritonitis, with vomiting, not controlled at any time, and died two days later. Perhaps here nephrotomy would have been better.

Mrs. F. F., aged thirty-seven years, admitted November 12, 1900. Diagnosis: ureterovaginal fistula; surgical kidney, right side. In 1893 patient had a double ovariotomy; in 1896 vaginal hysterectomy for carcinoma, and in 1897 another operation for repair of a rectovaginal fistula. Urine discharged through vagina after 1896, relieved for a few days, then returned, with marked pain in region of right kidney. Tumor could be made out at times. Nephrectomy November 14, 1900. Kidney very difficult to find, being situated way up under diaphragm, and cystic in character. Cysts evacuated; kidney removed; pedicle very short; wound packed with two strips of iodoform gauze; clamps left on pedicle, and removed at the end of seventy-two hours. Patient made a good recovery, and has remained well since.

Regarding removal of the kidney by transperitoneal incision, I have found it an exceedingly easy and convenient way of removing a large cyst or semisolid tumor, the patients doing well afterward. Of these there were four cases, referred to later under their respective classification.

Mrs. A. B., aged thirty-four years, admitted February 6, 1904. Diagnosis: hydronephrosis, left. Patient discovered tumor in left side of pelvis after delivery, three years ago. She was very large at time of delivery. Five months later passed large quantities of urine, containing dark amber colored material. Reduced in waist measure from thirty-four to twenty-eight inches, after this felt much better, and did well until June, 1903, when she was seized with pain in left side and vomiting, latter continuing almost constantly for a week, with chills and fever, and more or less ill

after this. Median incision to clear up diagnosis as to tumor originating in pelvis or in connection with kidney. Uterus and appendages found normal. Large tumor found occupying whole of left side of abdominal cavity. Trocar introduced and most of contents withdrawn. Posterior layer of peritoneum incised, vessels ligated, and kidney removed. On examination mass proved to be a pyonephrosis, with a good-sized stone in pelvis of kidney. Patient made a good recovery, remaining well since, all of her functions being performed in a normal manner.

There were two cases of hydronephrosis, probably due to movable kidney, in young women, entirely cured by simple aspiration.

Of nephrotomies, followed later by nephrectomies, there were 9 cases, as follows: Male, right side, 2 recovered; left side, 1 recovered. Female, right side, 3 recovered; left side, 3 recovered.

Mrs. C. I. S., aged thirty-seven years, admitted November 3, 1895. Diagnosis, pyonephrosis, right side. Patient had nephrotomy performed at her home one year ago, drainage continuing since. Never in good health; pain radiating down right side, usually lasting two hours, when she would then vomit and feel relieved. Paroxysmal attacks occurred at greater or less intervals for many years. Married at twenty-three years, and has had two children. Improvement took place under local treatment, and she left the hospital March 21, 1896, returning, however, in October of the same year, with same history of pain, and nephrectomy done. Patient a very fleshy woman. Kidney embedded in a mass of adhesions, hard to reach, and removed piecemeal. Uninterrupted recovery. February 1, 1897, returned to hospital with lumbar fistula, which was treated successfully, and she left in splendid condition, remaining so since.

Mr. C. E. H., aged fifty-eight years, admitted May 2, 1898. Diagnosis, pyonephrosis, left. Specific urethritis thirteen years ago, with cystitis two years later. Bladder washed out and sounds passed. Perineal section for intractable cystitis. Kidney opened and drained January, 1898, drainage continuing, with considerable urine mixed with pus. Two weeks ago unbearable pain,

left side, also some in right, and much pus in urine. Perineal opening still present. Usual nephrectomy, patient recovering fairly well from operation, but dying later from multiple abscesses of right kidney.

Mr. F. H. W., aged fifty-three years, admitted November 26, 1898. Diagnosis: pyonephrosis, right. Right side aspirated a few months previously and pus removed. Presented with chills, high temperature, pain in back and abdomen, vomiting, scanty, high-colored urine. Usual nephrectomy; clamps removed at end of seventy-two hours. Patient made a good recovery, remained well for five years, suffering for two years from lumbar hernia, relieved, however, by abdominal bandage and pad, but died suddenly in a jaundiced condition, probably due to gallstone perforation.

Mr. G. R., aged twenty-seven years, admitted June 28, 1899. Diagnosis: pyonephrosis, right. Illness began seven years ago, severe pain in right lumbar region, at first occurring about twice a year, later more frequently and severe, extending down ureter and to scrotum. He had acquired morphine habit. Nephrotomy, under ether, patient remaining comfortable for some few months, but finally obliged to submit to nephrectomy. Clamps used; good recovery, and well five years after operation.

Mrs. H. W., aged sixty years, admitted July 11, 1899. Diagnosis: pyonephrosis, left. Much soreness in side two years ago. Passed renal sand fourteen years ago. At times there is enlargement in left lumbar region and abdomen, with vomiting and irritation of bladder. Pain diffuse, not, however, following ureter to labia. States she has always had some kidney trouble. Mother of seven children and an unusually active woman. Nephrotomy necessary July 12, 1899; patient in a collapsed condition, but made a good recovery in general health; however, drainage continued, and kidney painful at times. Readmitted November 17, 1899, nephrectomy; clamps removed at end of forty-eight hours. Uninterrupted recovery, and well at present time.

Mrs. H. M. B., aged thirty-five years, admitted November 20, 1899. Diagnosis: abscess of right kidney. Patient had an opera-

tion on right kidney six years ago, at her home, when drainage tube was introduced, and left in several months, the discharge continuing. Tube removed, but discharge continued, and sinus formed, finally healing. Three weeks ago seized with severe pain, right side, swelling appeared, and later opened by home physician, but discharge continued.

Nephrectomy; wound healed nicely, and patient well when last heard from.

Miss K. S. S., aged thirty-one years, admitted April 11, 1902. Diagnosis: pyonephrosis, left side. History of cystitis and menstrual trouble; dilatation and curettage, but condition not relieved. Bladder washed out. Many attacks of pain, left side, with much pus in urine. Kidney aspirated at patient's home; much pus evacuated and an earnest effort to remove kidney, but so adherent, and her condition so unfavorable, cavity opened, packed with iodoform and rubber drainage. Good result for a time, then old symptoms presented; much pus in urine, irregular menstruation, and sacculated kidney removed, clamps being used. Marked improvement; urine normal; a gain in weight, but later developed a pelvic abscess, which was drained through right incision, low down, above Poupart's ligament. Improvement for a time, but at present, while there is good drainage, and sinus washes out thoroughly, she is gradually failing.

Mrs. M. V. B., aged fifty-seven years, admitted January 21, 1903. Diagnosis: pyonephrosis, right. She came to my office January 12th in so serious a condition I was glad to get her home without a collapse. Temperature, 103°; pulse, 130. On admission to hospital she gave the following history: cystitis ten years ago, supposedly cured. Present illness began September 1, 1902. Pain in right lumbar region; swelling near spine size of an orange. Nephrotomy October 3, 1902. Large amount of pus evacuated and T-drainage tube inserted; one week later patient became delirious and removed to Pavilion F, for mental condition, under Dr. Mosher's care. She remained about the same for ten days, recovery then ensued, there was a free discharge, and nephrectomy done April 16th. Rather difficult on account of numerous adhe-

sions. Marked improvement in urine followed operation; sufficient in quantity; wound healed very slowly, but ultimate good recovery, and in health at present time.

Mrs. H. D., aged forty years, admitted October 4, 1904. Diagnosis: perinephritic abscess. Patient previously in hospital with pyelitis; much pus in urine; enlargement of left kidney and abscess; nephrotomy and drainage; condition precluding nephrectomy. Patient improved; a slight sinus remained, which closed only intermittently, with pus and free discharge occurring. During past year much pain, with occasional fecal discharge. History of tuberculosis, but no cancer in family. Eighteen years ago, after birth of first child, passed small stones in urine. She now has two distinct sinuses; one backward toward the spine, the other downward, communicating with large intestine. Nephrectomy. Every remaining portion of left kidney dissected out, with much difficulty. Diseased areas removed; opening in intestine located just above sigmoid flexure, posteriorly. Edges freshened and brought together with silk sutures. Usual drainage. Patient discharged in greatly improved condition. Two silk ligatures have since worked out of sinus, and a limited amount of fecal discharge for a short time, but patient now in excellent condition. Laboratory report: chronic suppuration, involving kidney; granulation tissue of sinus.

It will be noted that all of these cases recovered from the two operations and remained well with the exception of Mr. H. and Miss S., he dying a few months later, as stated, from multiple abscesses of remaining kidney, and she, while still alive, gradually losing ground.

I have been greatly impressed with the study of tuberculosis of the kidney, as to invasion from below, or by systemic infection. It is to be noted that these patients complain of other symptoms than the real kidney lesion itself; that is, they often have bladder complications, and later, not receiving benefit from treatment, it dawns upon the physician as a possible lesion of the kidney, the diagnosis of tuberculous trouble at last being reached.

There were 7 of these cases, as follows: Male, right side, 1

recovered; left side, 2 recovered. Female, right side, 1 recovered; left side, 3 recovered.

Mrs. A. L., aged forty-eight years, admitted March 30, 1893. Diagnosis: pyonephrosis, right. Very good family history. Has had five children; three miscarriages. Fall of 1889 noticed enlargement in right side, with pain from posterior crest of the ilium to the groin and round ligament. Same attacks previous year, and morphine necessary to control pain. Hot packs afforded some relief. Urine contained large amount of thick mucoid deposits, with much pus. Nephrectomy revealed well-marked tuberculous kidney. Good recovery, and in excellent health eight years after operation.

This case illustrates the possibility of curing this trouble if diagnosis is made early and operation done promptly.

Mr. H. F., aged fifty-two years, admitted February 26, 1897. Diagnosis: tuberculous kidney, right side. Family and personal history negative. Patient had gonorrhœa four years ago: right testicle enlarged; a year ago had an attack of intestinal colic, then following exposure to cold passed blood in urine for several days. Left work, cigarmaker, two months, then returned for four months. June, 1896, another attack; no colic; catheterized, with pain for three or four days. Passes blood in urine whenever nervous. November passed pieces of tissue and clotted blood, with severe pain previous to and during passage through urethra. Swelling in right side larger before attacks, decreasing with flow of urine. Latter examined each day after admission to hospital; albumin always abundant; occasional casts; urea normal.

Nephrectomy was performed, and, while recovery was rather slow, he had improved decidedly when discharged, and has remained in good health since.

Mrs. E. M., aged sixty-four years, admitted October 25, 1898. No tuberculous or cancerous trouble in family. Present trouble began one year ago, following a strain. September, 1898, had a chill, followed by fever, with severe pain in back and enlargement over left kidney. Large amount of pus removed by aspiration. Nephrotomy October 4th; a quantity of pus withdrawn, and

drainage tube inserted. Patient recovered nicely, but drainage continued, and nephrectomy revealed a tuberculous kidney. Excellent recovery, and in good health at present time.

Mr. T. F., aged twenty-nine years, admitted March 22, 1899. Diagnosis: sinus following abscess of left kidney, which was curetted November, 1898. Discharge of pus constant, though not great, requiring much attention. No pain; bowels regular; appetite good; urine clear and normal. Five years ago had malarial fever, followed by pain over left kidney, radiating down groin; urine milky; some pain in left testicle.

Nephrectomy; kidney pale and containing numerous pus cavities. Clamps; good recovery. Laboratory report: tuberculosis of kidney.

Mrs. E. S., aged thirty-five years, admitted September 18, 1900. Diagnosis: tuberculosis of left kidney. Much pain in left side; retention of urine, with leucorrhœa. Trouble began four years ago, when she urinated every ten minutes, accompanied with much pain across kidneys. Bladder washed out, but no improvement followed, and discontinued. Ten months ago had abscess in left side, which discharged pus for several days. Has recently had chills, followed by high fever. Fluctuating tumor found on examination, size of a cocoanut, and very tender on pressure. Urine, 1010; acid; no sugar; small amount of albumin; much pus and amorphous urates, but no tubercular bacilli found. Nephrectomy. Patient made a good recovery, and has remained well since. Diagnosis confirmed by laboratory report.

Miss M. F., aged thirty years, admitted July 27, 1901. Diagnosis: pyonephrosis, left side.

Past history negative, although patient never very strong. Two years ago had an attack of vomiting; bowels constipated; bladder irritation; many attacks of sudden, localized pain, gradually increasing in severity and frequency. Slight thick vaginal discharge. Patient poorly nourished: somewhat undeveloped; skin and mucous membrane pale; pulse poor in volume and tension; artery walls soft. Urine, 1010 to 1028, and at times quite numerous pus cells. Diagnosis of possible tuberculosis also made. Usual

nephrectomy; good recovery. Laboratory report showed tuberculous kidney, probably of blood origin, and due to lodgement of tuberculous embolus. November, 1901, sinus not closed. Slight discharge, somewhat purulent in character, had continued since operation, but ceased immediately after removal of silk ligature knot, and patient now in fine condition.

There was a total of 8 cases of malignant growths, as follows: Sarcoma: Male, right side, 2 recovered, 1 died; left side, 1 died. Female, right side, 1 recovered; left side, 1 died. Carcinoma: Female, right side, 1 recovered. Hypernephroma. Male, left side, 1 recovered. These cases present some rather interesting phases.

Mrs. D. C., aged forty-seven years, admitted September 12, 1895. Diagnosis: sarcoma of left kidney. Patient well up to one year ago, when there was an enlargement in left side; pain in voiding urine; persistent vomiting; emaciation. Tumor gradually increased, filling entire left lumbar region, right of median line, up under border of left ribs, and patient very ill. Mass felt elastic, as though fluid present contained in a thick sac; distinct resonance in lumbar region near spine. Albumin in urine; some pus; hyaline and granular casts.

Incision in left linea semilunaris and tumor removed, weighing twenty-six ounces. Patient greatly shocked, but rallied well; however, only two ounces of urine obtained by catheterization, and death, from exhaustion, twenty-four hours later.

Autopsy: interstitial nephritis, right kidney; sarcoma, left kidney.

Mr. E. A. P., aged fifty-seven years, admitted May 6, 1895. Diagnosis: hydronephrosis, associated with sarcoma, right kidney. Family history nephritic. In 1890 patient passed gravel, with some pain, and a large mass felt in right side, with a sensation of pressure. Lately, increase of urine, but otherwise negative. Aspiration May 4th. Nephrectomy attempted May 8th, but large cyst attached to right kidney, sarcomatous in character, dangerously near ascending vena cava and renal vein, and impossible to remove kidney *en masse*. Large portion removed, however,

and clamps applied. Patient did not rally well, and died May 12th.

Master E. H., aged four and one-half years, admitted September 5, 1900. Diagnosis: embryonal adenosarcoma, right kidney. Family history negative. Patient always well as a child. Six months ago passed several clots of blood in urine; has severe eructations of gas. A few days ago first noticed small lump in right side, which has grown larger since. No chills or fever; no nausea or vomiting; bowels fairly regular at present, but previously constipated; not confined to bed. Heart and lungs negative; movable tumor in right side; tense, fluctuating, not painful, size of closed fist. Urine cloudy, amber, 1020; acid; no sugar; small amount of albumin, amorphous urates, and a few granular and hyaline casts. Nephrectomy difficult. Mass removed; sarcoma. Patient made a good recovery, but died six months afterward from a return of the disease.

There was one well-marked case of carcinoma, as follows:

Mrs. L. K. B., aged sixty-two years, admitted January 7, 1901. Diagnosis, carcinoma of right kidney. Family history negative. In September, 1900, patient had severe pain in right side, with tumor in appendical region; later, stomachic distress, with vomiting, loss of appetite, etc. Lost thirty pounds in weight in nine months, with constipation and occasional emesis. Pain in region of tumor intermittent; patient anæmic; arteriosclerosis; tumor, apparently implicating appendix, size of a cocoanut, tender and painful on pressure. Operation; large quantity of broken-down tissue removed, composed of remains of kidney, with multiple adhesions involving contents of peritoneal cavity. Appendix not recognized. Irrigation; drainage; good recovery. Growth returned in six months, and patient died within a year after the operation.

The following case is rather interesting:

Mr. G. W., aged thirty-five years, admitted May 17, 1905. Diagnosis: hydronephrosis, left kidney. Family and personal history negative. Five weeks ago seized with severe pain in left lumbar region: no vomiting or constipation or urinary complications noted. Attack lasted three days. One week ago noticed

tumor, which has increased greatly since. Urine contained albumin, casts, epithelium; otherwise negative. Hæmoglobin, 85 per cent.; red cells, 4,400,000; white, 9000. Protuberant mass, size of football, fills left side completely; dull on percussion over entire mass. Operation through left linea semilunaris; tumor exposed; colon pushed to median line; aspiration with large needle, negative. Incision in tumor and about 1500 c.c. of brain-like substance scooped out. Nephrectomy, tumor springing from superior pole of kidney. Small incision in left lumbar region for rubber drainage. Urine, June 6th, normal, and the patient discharged June 7th, recovered.

Pathological report from Dr. Pearce: "Adrenal tumor, implicating kidney, together with extensive central necrosis, softening and hemorrhage, with calcification and bone formation in the capsule."

I have watched these cases with particular interest, as it will be observed that the mortality list among malignant growths of the kidney is quite serious. I have an impression that sarcoma in children is very rapid in its development; that very few cases admit of an operation, and when one is done a very small percentage recover. This has been my experience in reviewing a number of cases seen in consultation during my years of surgical work. In adults, however, this observation apparently does not hold so good.

Of decapsulation of the kidney for nephritis there were 2 cases.

Mr. H. H., aged twenty-nine years, admitted January 26, 1904. Diagnosis, interstitial Bright's disease. Family history negative. Patient had specific urethritis in 1899, lasting for two years. Informed that he also had pyelitis. Since then has had pain in right side, running down to testicle. Six months ago had a severe attack of pain following gymnastic exercise, with intermittent attacks since. Urine at present negative, save for large quantities of amorphous urates, hyaline casts, and albumin. Operation February 4th, following a careful course of medical treatment. Both kidneys found small; right not movable. Aspiration negative. Capsules freely incised and stripped from surface. Uneventful

recovery, and, April, 1905, patient enjoying the best of health, having gained thirty pounds. The urine improved markedly after the operation.

Mrs. C. E. K., aged twenty-four years, admitted July 29, 1904. Diagnosis: parenchymatous nephritis. Family and past history negative. Present trouble began about one year ago, with usual symptoms. Urine contained albumin, 4½ per cent., a few red cells, but otherwise negative. White blood count, 12,580. Patient discharged.

August 22d much improvement, following medical treatment. Readmitted January 22, 1905, with more marked symptoms, urine now containing hyaline and granular casts. In consultation, decapsulation of both kidneys advised, and performed February 13th. Right kidney lobulated; cortex hemorrhagic, soft and flabby. Aspiration negative. Kidney size of two fists. Left side showed kidney somewhat contracted, otherwise practically normal. Urine before operation, thirty ounces daily; after, forty-six ounces. Pregnant three months' uterus emptied, cervix repaired, and good recovery. Patient discharged much improved. May 28, 1905, she reported an increased amount of urine, and bettered in constituents; physical condition excellent. Former headaches and mental symptoms have abated, but she tires easily after much exertion.

Of traumatism and injuries of the kidney the group comprises 6, as follows:

Mr. B. B., aged twenty-three years, admitted August 6, 1888. Pistol wound, 22 calibre, in left lumbar region, ball passing completely through body. Entered hospital in a state of collapse; frequent desire to urinate; urine bloody, and he presented all the symptoms of a wound of the kidney. Absolute quiet maintained. Patient rallied quickly from the shock; next morning urine contained less blood; he gradually improved, and was discharged two weeks later, the urine then normal. In 1893 patient in excellent health.

Mr. J. W., aged nineteen years, admitted October 12, 1890. Pistol wound, 38 calibre, of left hypogastric region. After a delay

of twelve hours in getting the consent of his family, a section was done. Left kidney had sustained a stellated fracture, hemorrhage had been free, and into the retroperitoneal space, with some clots in peritoneal cavity. Renal artery wounded at pelvis. Nephrectomy, but patient died twenty-four hours later.

This patient passed little blood in urine. The laceration of the pelvis of the kidney evidently destroyed the continuity of the ureter, and he should have been operated upon at once, the delay making the case hopeless.

Mr. B. R., aged forty years, admitted November 6, 1897. Diagnosis: pyonephrosis, left side.

Family and past history negative. September 19th patient stepped off curbstone, striking heavily on left foot, followed by sudden pain in region of left kidney, which continued for several days. Large tumor presented in region of left kidney, yielding sixteen ounces of pus on aspiration. One week later nephrotomy, with drainage, latter continuing up to present time. Medical treatment, irrigation, and patient improved. Entered hospital February 14, 1901, in excellent condition for nephrectomy. For past four years had suffered in nowise save for frequent dressing of the sinus, remaining from former nephrotomy. When peroxide of hydrogen was introduced into sinus, which still persisted, it would produce a severe cough, and his condition would become alarming for a few moments, giving evidence of a connection between the pleural and old abscess cavity. Usual nephrectomy, and patient left hospital greatly improved, but still has a sinus.

Mr. F. G., aged twenty-one years, admitted March 30, 1899. Diagnosis: pyonephrosis, left side. Sustained an injury five years ago, but no flesh laceration, was confined to his bed for a month, never regaining former health, and in bed again the past month. Urine apparently normal; bowels constipated; slight tenderness over left side, with some enlargement. Considerable loss of weight for past year, with occasional night sweats. Aspiration gave several ounces of pus, followed by nephrotomy. Patient discharged May 5th, in excellent condition, but with a sinus. Steady improvement, with intermittent closure of sinus, followed by new

abscesses, up to May 15, 1902, when he re-entered the hospital for a nephrectomy. Usual operation attempted, with excision of sinus, but, in following out pus cavity, I found it extended a little beyond the median line, and implicated the left pole of a horseshoe kidney. Removal up to point of separation, and cavity packed. Good result, with complete closure for about three months, when another abscess formed. Drainage once more established, and uninterrupted improvement, until September, 1903, when there was another relapse, but urine in excellent condition. October 6, 1903, sinus opened up, curetted and packed. From this time on there was rapid improvement, only a small sinus now remaining, and cavity apparently completely filled in. The right pole of the kidney is doing its work thoroughly, and urine entirely normal.

Mr. H. B., aged thirty-two years, admitted June 21, 1904. Diagnosis: movable right kidney, following traumatism. Accident occurred three years ago while wrestling, followed by intermittent dark urine and some distress in back over right kidney, together with nausea and vomiting, more pronounced of late. Urine practically normal, save for a few casts. Usual nephrorrhaphy, with good recovery, and patient well at present time.

Mrs. G. G., aged forty-six years, seen in consultation June 16, 1904. In stooping over suddenly seized with violent pain in right side, nausea and vomiting. Marked fulness in lumbar region. Urine diminished in quantity, with slight amount of albumin, otherwise negative. Hot applications employed, and during next twelve hours tumor subsided, urine gradually increased, becoming normal, and patient made a good recovery in a few days without operative intervention. I considered this a case of acute displacement of the kidney.

Of cases of renal nephralgia, associated with suspected stone in the kidney, I was not able to confirm my diagnosis in all instances by exposure of the organ, as the six cases herewith presented illustrate. In only one was the diagnosis of stone confirmed by exposure of the kidney.

Mrs. C. C., aged sixty years, operation done at her home. Patient gave a history of pain in right side, and at times well-

marked renal colic, with albumin and pus in urine. There was a well-defined tumor in right lumbar region, believed to be a condition of pyonephrosis. Kidney exposed; found to be large, white, aspirated, capsule split, but no pus or stone found. Capsule sutured to fascia, and gauze packing introduced. Patient made an excellent recovery, urine improved, and she was well for two years after the operation, when she died very suddenly of cerebral hemorrhage. No doubt this was a case of movable kidney.

Miss G., aged twenty-two years, admitted October 7, 1902. Diagnosis: movable kidney, right, with suspected renal calculus. Six months ago patient had a severe attack of pain in right side, leg drawn up, pain extending to region of appendix and labia of right side, with frequent desire to urinate. Urine contained oxalate of lime, but no blood or pus. She was relieved by medical treatment, and returned to her work, trained nurse, suffering, however, more or less tenderness in that side. One month ago was seized with a second similar attack, so intense that examination for locating the kidney was impossible. Anæsthetic given and kidney explored. Attempt to examine the bladder and ureters not successful, but left kidney apparently normal. Under ether limb straightened without difficulty, and kidney proved to be movable and enlarged, the macroscopic appearance so indicative of tuberculosis it was deemed best to remove it. Usual nephrectomy. Excellent recovery, and other kidney doing its work well, although there is an occasional trace of albumin in urine. Pathological report stated; subacute parenchymatous nephritis, with multiple areas of necrosis. Patient has since married, and in good health May, 1905.

Mr. J. H. C., aged twenty-eight years, admitted December 21, 1903. Diagnosis: renal colic. Specific urethritis at twenty-six years of age, complicated with orchitis, but good recovery. Patient drank moderately, not of late, however, and careful in the use of tobacco. About seven years ago had very severe pain over region of left kidney, down course of ureter to bladder, with vomiting, then pain would leave as suddenly as its onset. These attacks occurred intermittently until past six months, when he has had

four severe ones. Urine: acid, 1030; crystals of oxalate of lime, and a few granular casts. Bowels regular; no irritation of bladder. In consultation, diagnosis of renal calculus, and exploration advised. Kidney exposed with some difficulty, thoroughly explored, but no calculus found in same, nor in ureter, nor was the kidney sufficiently movable to indicate a kink in the ureter. Capsule of kidney split, turned back for some distance, and fixation done. Wound healed kindly, and patient discharged January 22, 1904. Previous to and following discharge patient had a thorough course of medical treatment, drinking freely of soft water, taking alkalies, etc. He improved for a short time only, and readmitted February 19, 1904. There was a repetition of old symptoms, but more severe, pain not being alleviated by morphine. Old wound opened, ureter followed nearly entire distance, but was not able to detect a calculus. Kidney large, with ecchymotic spots on surface, cortical portion indicating a hemorrhagic condition, and complete nephrectomy done. Uninterrupted recovery, and in absolutely normal health since. Laboratory report: kidney hemorrhagic, but otherwise normal. Urine improved immediately after operation, and has continued normal since.

Mr. A. M., aged twenty-three years, admitted September 15, 1904. Diagnosis, neuralgia of left kidney, with possible renal calculus. Kidney exposed in usual manner, exploration with aspirating needle failed to locate stone, capsule split, wound packed with gauze, and patient made a good recovery, being in excellent health six months after operation, and free from all pain.

Of the irregular classification there are four cases of interest, as follows:

Mr. C. A. L., aged twenty-three years, admitted April 17, 1894. For many years patient had suffered from pain in left side. During the past six months there has developed a distinct enlargement, involving the kidney. Nephrotomy done, patient made a good recovery, improved in health, and was instructed to report later, if the sinus did not heal. He did so well, until late in the fall, that he neglected proper care and attention, and, after considerable exposure, re-entered the hospital December 19th, in a very serious

condition, and without further operative intervention possible; died December 21, 1894.

This fully illustrates how some patients procrastinate, and, even after being helped, will neglect themselves until, when they finally do present for further treatment they are almost beyond hope.

Another interesting case is that of Miss A. S., admitted June 6, 1898. Diagnosis: pyonephrosis, right kidney; cyst very large; aspirated, and over twelve pounds of fluid pus removed; second aspiration, soon after first, eighteen pounds removed. She was advised to return to the hospital for surgical treatment, to which she consented, but failed to do so, and the case lost sight of. This is the largest amount of fluid I have ever removed from an abscess or cyst of the kidney.

Mrs. P. McD., aged fifty-three years, admitted May 21, 1901. Diagnosis, cystic kidney, right side. About ten years ago had continuous pain in stomach, extending over entire abdomen, with nausea and vomiting quite severe at times. Appetite nil; bowels regular; urine cloudy, 1026, acid; no sugar; albumin abundant; heavy, white sediment, and a few hyaline and granular casts. Menopause three years ago. Has lost much in weight; respiration difficult; heart normal; abdominal walls very flat; tumor, size of cocoanut, on palpation, in right side, movable and irregular in contour. Operation through right semilunaris. Large cystic kidney, which ruptured in trying to remove it. Pedicle tied with No. 1 silk; wound closed with silkworm-gut sutures. Patient made a good recovery, and has remained well since. Laboratory report showed specimen one of extreme hydronephrosis, with atrophy of kidney. On leaving the hospital urine yellowish-red, 1028, acid; no sugar, mucous sediment, squamous, epithelium, bacteria, pus cells, but no casts.

Miss J. V., admitted July 31, 1903. Diagnosis: movable kidney, left side. First, nephrorrhaphy; second, resection of kidney; third, nephrectomy. First operation did not afford relief. On exposure of kidney the second time a distinct abscess cavity could be made out in lower third of the organ, so isolated that I determined to resect and drain. Patient did well for about six weeks,

then showed more marked evidence of distress, temperature, and pulse. Old wound, therefore, reopened and nephrectomy done. The case proved to be one of tuberculosis. Patient had made a good recovery.

When last heard from, since paper was written, Miss V. has died from general tuberculosis.

Mrs. M. B., admitted November 16, 1903. Diagnosis: cholelithiasis and floating kidney, right side. For two years has suffered from occasional severe pain, radiating down right ureter, with blood in urine at times. Past six months attacks more frequent and severe, and amount of blood in urine quite serious. Segregation of urine evidenced blood from right side. Four months ago had an attack of gall-bladder trouble, jaundiced, clay-colored stools, and enlargement of the gall-bladder. Cholecystotomy November 17, 1903. Large, single stone in gall-bladder. Examination of kidney presented an irregular appearing surface. Posterior wall of peritoneum split and nephrectomy done. Pedicle ligated with silk, and peritoneum brought over surface. Wound closed in usual manner in such cases. Sinus in gall-bladder remained for a long time, but finally closed in an intermittent manner; however, patient in excellent health at present time, with no blood in urine since operation. Macroscopic appearance of kidney showed a number of hemorrhagic infarctions. Pathological report: Slight, chronic pyelitis; slight, chronic nephritis.

For many years my work has been largely along the lines of abdominal surgery, and I wish to speak of the following cases to illustrate errors in diagnosis:

Miss B. H., aged twenty-one years, admitted May 1, 1890. Diagnosis: unilocular ovarian tumor. Fluctuating tumor in right side, filling pelvis, and extending well up toward liver. On median incision uterus and ovaries found normal. Careful exploration proved the tumor to be a cystic kidney. Transperitoneal operation done without any great embarrassment; vessels of pedicle ligated with silk, peritoneal layers brought together, wound closed with interrupted silk sutures, and a good result followed. I saw this patient a number of times the following year, and she always

presented a condition of perfect health, passing a normal quantity of urine, and in every way seemed well.

Mrs. A. B., admitted May 24, 1900. Diagnosis: ovarian cyst, with possible deep fibroid in pelvis. Median incision, and on exposing tumor it was found with a thickened cyst wall, and proved to be a case of pyohydronephrosis of right kidney. Patient made an excellent recovery, and is well at the present time.

Out of all my abdominal work these two cases are the only ones occurring where there was an error of diagnosis between an ovarian cyst and cystic kidney.

Mrs. S. L., aged forty-five years, admitted January 21, 1900. Diagnosis, pyohydronephrosis, right side. Patient never had any serious illness. Was taken with severe pain in right side five days ago, with some nausea and vomiting. This continued, increasing in severity; bowels very constipated, but cathartics acted well. Pain, however, continued, there now being marked resistance and tenderness on right side, with some dulness. The case was a puzzling one as to diagnosis, there being one of three conditions to consider—*i. e.*, gall-bladder trouble, possibly an abscess from a retroperitoneal appendix, possibly a perirenal abscess. Oblique incision was made for the purpose of examining the kidney, abscess cavity soon reached, washed out, and drainage tube introduced, believing we had a retroperitoneal abscess to deal with, in connection with the appendix. Patient did nicely, but at the end of ten days the discharge became distinctly bile, and she passed several gallstones, later making a good recovery.

Mrs. A. F., aged fifty-nine years, admitted September 3, 1903. Diagnosis of tumor of right kidney uncertain. Family history negative. Present trouble began about two years ago. Patient lost thirty-five pounds in weight; bowels extremely constipated; no bladder intolerance; abdomen never painful. First apprised of the presence of a tumor by her physician in June, 1902. For past six months appetite has grown less and less, until now she has no desire whatever for food. Has never vomited; no attacks of pain until June, 1902, when one presented with diarrhœa. Tumor felt in right lumbar region, extending beyond median line, evi-

dently implicating right kidney. An attempt to catheterize right ureter was not successful. Median incision 6 cm. long, between ensiform cartilage and umbilicus. Upon opening abdomen there was an escape of a large amount of dark, serous fluid. Tumor, size of a cocoanut, found lying in right side of abdomen. On careful examination it was found to spring from right kidney, which was apparently horseshoe in form. Tumor cystic in character. Two ounces of blood aspirated from cyst. Tumor involved right lobe of liver and pyloric end of stomach, and could not be removed. Wound closed with silkworm-gut sutures; one piece of iodoform gauze in lower angle. Sinus remained for some time after patient was discharged, but finally closed; she made a good recovery, and in excellent health at present time. Examination of urine in this case was very negative. The case was probably one of cholecystitis.

In approaching the kidney from behind I prefer the oblique incision, such as Kelly has so beautifully illustrated in his paper on "Exploration of the Ureter," and in fixing the kidney catgut for capsule and fascia; silkworm-gut through and through for remaining portion of skin and muscle, introducing iodoform gauze, removing the same in four or five days, and silkworm on tenth day.

The one case of hernia reported resulted from an old incision, parallel with the spine and transversely through the muscle, causing a lumbar hernia, but none of the others presented this complication.

In a review of the cases presented in this paper, one is impressed with the very excellent results following the operation of fixation of the kidney. In the hands of all operators the mortality list is exceedingly small. Wearing of a bandage, with the kidney pad, is irksome to many patients, who gladly consent to surgical intervention, when the prospects of recovery are so good.

The combined operation of nephrotomy and nephrectomy, for abscess of the kidney, is appropriate for such cases as will not bear too long an operation, and where there may be a large kidney, made up of multiple abscesses in such a way as to make manipu-

lation of the organ very difficult. Simple drainage, however, benefits the patient for a time, and often causes a diminution of the mass to be removed later. In the purely cystic form of kidney a true pyonephrosis, an immediate nephrectomy is proper in the majority of cases. In removing a large sacculated kidney I have saved much time in introducing my fingers or hand inside the sac, drawing it out, and in this manner easily separating attachments. It must be borne in mind that following a nephrotomy or nephrostomy a very fair number of cases recover without further intervention.

In a large pus kidney, especially multiple abscesses, there is always some danger in nephrectomy causing an infective peritonitis.

In traumatisms of the kidney firmness and decision on the part of the surgeon is an absolute necessity. There is no other form of emergency surgery more exacting.

In cases of a movable or floating kidney, giving such marked symptoms that the surgeon is often led to believe that he has a stone to deal with, we must admit our diagnoses are very far from correct, and the cases here reported were disappointing by reason of not finding a calculus present. It is sometimes difficult to diagnose between a neuralgic kidney and one containing a calculus in its pelvis. Splitting of the capsule relieves pain in cases that can be classified only as a nephralgic condition.

It is yet a mooted question as to how much can be accomplished by resection of the kidney for relief of abscesses and growths.

The cases of tuberculosis reported indicate decidedly the importance of an early operation, and give a most encouraging outlook for these patients, regarding permanent recovery, for it is seldom both kidneys are diseased.

In incipient tuberculosis of the kidney we have yet much to accomplish in making the examination of the urine more positive in detecting the bacillus of tuberculosis. Laboratory work thus far has not aided the writer much.

As to the use of ligatures or clamps, if the pedicle is exceedingly short and difficult to ligate, clamps are advisable. They are easily applied, and, as used in the cases reported, the results were

excellent. There was no hemorrhage on removal at the end of forty-eight or seventy-two hours, and the patients convalesced rapidly. When using ligatures the writer is reluctant to dispense with fine silk.

The cases of hydronephrosis, yielding to aspiration, are of interest; the possibility of such a result, in these simple cases, should always be borne in mind, and the treatment attempted.

One cannot overlook the fact that the proportion of diseased kidneys is so much greater on the right than on the left side, and in females than in males.

A differential diagnosis between gall-bladder lesions, the kidney, the cæcum and its anatomical relations, presents strongly in a paper of this kind. Surely, the right abdominal cavity is to be greatly respected by the surgeon.

It will be observed that in a total of about 90 patients there were 123 operations done. This is readily accounted for because of the patients requiring more than one operation.

The percentage of mortality is exceedingly small, malignant disease and abscesses of the kidney producing the greatest number.

Malignant growths give us our mortality list, and yet there is much hope for these cases if reached early.

Surgery of the kidney is becoming more and more exact with the splendid advances made in methods of examination of the pelvis and urine, as to the possibility of one kidney being diseased or absent.

Errors of diagnosis will occur less frequently as methods of examination become more perfect.

The writer desires to express his thanks to Drs. Blumer and Pearce, and assistants of the Bender Laboratory, in examination of the specimens, with reports; also to Drs. Ward, Hun, Neuman, William Faust, Haner, Campaigne, Pearson, La Moree, Powell, Theodore Bailey, Ryan, Wentworth, Kittell, Buckbee, Jansen, Perry, Cook, Sternberg, MacFarlane, Ball, Witbeck, Mitchell, Featherstonhaugh, Boyd, Bristol, Lomax, J. M. Moore and many others of my professional friends who have referred their cases to me.

## DISCUSSION.

Dr. William J. Mayo, of Rochester, Minn.

I have been much interested in this paper, and I should like to ask the author a few questions in reference to tuberculosis of the kidney, of which he reports a number of interesting cases. First, how early he has operated upon cases of this kind? Second, if he took out the ureter or considers it necessary to do so in every case? Third, if any of the cases in which nephrotomy for tuberculosis has been done have been followed by permanent good results?

Recently, I have gone over the histories of some thirty-six nephrectomies for tuberculosis, and have been much interested in finding that a large number of people were supposed to have tuberculosis of both kidneys in the early stage because there were no symptoms referable to one kidney more than the other; but simply a number of tubercle bacilli found in the urine, with excessive or frequent urination at night. On careful examination it was shown in the majority of cases that the tuberculosis was confined to one side. I think that many if not the majority of cases of tuberculosis of the kidney are one-sided to start with and in this stage curable by operation. Postmortem examinations are misleading, as in the later stages the second kidney becomes infected and the autopsy shows double disease, giving an exaggerated idea of the percentage of cases in which tuberculosis of the kidney is double.

In regard to the ureter, Israel and some of those who have the largest experience in cases of tuberculosis of the kidney consider it necessary to remove the ureter. From our experience we would say that it is bad practice to remove a part of the ureter; it should be removed absolutely if at all, the end of the ureter being excised down to the bladder, and closed, just as one would treat a pyosalpinx, by excising the horn of the uterus. For some six years we have, after nephrectomy for tuberculous disease, injected into the ureter 10 to 15 minims of pure carbolic acid, and then ligated with catgut and attached the stump to the lower angle of the wound underneath the muscle. In none of the subjects so treated have we been compelled to remove the ureter secondarily. We have in a number of other instances, both in our own cases and those operated by other surgeons, had to remove the ureter secondarily for tuberculosis of the ureter following primary nephrectomy.

I would like to hear the experience of others as to whether we should in every case remove the ureter at the time of the operation or not.

As to the third proposition, we have never had a case of nephrotomy

or partial nephrectomy for tuberculous disease remain cured, while we have a number of patients permanently cured after nephrectomy in like conditions.

Dr. N. B. Carson, of St. Louis.

As the essayist spoke of the difficulties attending the diagnosis in some cases of floating kidney, I wish to say that I had in my experience last year a very interesting case, where a diagnosis of floating kidney was made by everyone who saw the woman. I operated later with the intention of fixing the kidney. I found the kidney slightly movable, but not floating. I afterward had other surgeons examine the patient —among them Dr. Howard Kelly, and he said unquestionably we had a case of floating kidney to deal with. This was after the operation for fixation of the kidney had been done. I told him I had fixed the kidney, and I was sure it was not floating. He made another examination and was uncertain. Later I operated again, and instead of a floating kidney I found what might be called a movable or floating right lobe of the liver. The patient had an enlarged gall-bladder, about the size of a kidney; this was fixed to the liver; it contained a number of stones. But the right lobe of the liver was so freely movable that we could float the gall-bladder, so to speak, all over the abdomen, and it corresponded so closely to the shape of the kidney that everyone who examined the case made a mistake. The patient made a good recovery.

Dr. Archibald MacLaren, of St. Paul.

This very interesting paper of Dr. Vander Veer prompts me to say a word or two in connection with one or two points that have been raised by Dr. Mayo—and first in regard to a point which I got from him a few months ago—namely, the ease with which we can remove a kidney after resection of the twelfth rib. I found this of very decided advantage, and in one case upon which I have operated since I obtained a great deal of comfort in resecting the twelfth rib on account of the ease with which the operation of removing the kidney was done, although I opened the pleura. The opening in the pleura was easily plugged with a rope of iodoform gauze, until breathing sounds were stopped, and this will not give any inconvenience if we have not already opened the abscess.

In regard to nephrotomy in tuberculosis of the kidney, I think we have exactly the same proposition to contend with that we have in vaginal section in tuberculous pelvic abscess. I have seen a number of cases of tuberculous pelvic abscesses that have been opened and drained,

and the patients would fade like a flower. I do not think I have ever seen any class of patients that would run down hill as rapidly. This is due to the tuberculous ulceration of the mucous membrane in the dilated and opened fimbriated end of the Fallopian tubes.

In the kidney we have the same condition of affairs, the ulceration of a mucous surface, with a mixed infection. Under these circumstances these patients never do well; they always do badly, and they very soon wear out.

Dr. Vander Veer. With reference to Dr. Mayo's question as to whether the tuberculosis was confined to one kidney or not, I will say that the cases I reported were exceedingly interesting to me. I have a history of those cases, and only one death has occurred since the operation among that number.[1] Some of them go back to a period of ten years, some six years, some four years, the tuberculosis being confined to one kidney, and in which I did nephrectomy.

In regard to the operation of nephrotomy in those cases of well-marked tuberculosis in which it became necessary to remove the kidney, I will say that the tuberculous condition was confined to one kidney. I have no record of bilateral tuberculosis of the kidney.

Regarding the removal of the ureter, I must be frank and say that in the first few cases I operated on I did not remove the ureter, and of that number one case relapsed, and I had to do a secondary operation. Of two other cases, one was treated by carbolic acid by direct application. This case did well later on, and had no unpleasant results. Of late, I make every effort to remove the ureter thoroughly, going down as low as possible, but not to the point of excision of a portion of the bladder. I believe those cases of nephrotomy, followed by relapse, really call for another operation, or a more thorough operation in the beginning.

As to Dr. Carson's case, I report almost a duplicate of it in a case of right-sided sarcoma which involved the gall-bladder and right lobe of the liver.

With reference to the incision, I used to make an incision parallel to the spine and when necessary a transverse incision. I recall one case reported in which I got a hernia, and since then I have made the anterior oblique incision, and I must say that I have removed large kidneys in that way; it affords every opportunity and in addition gives an excellent chance of reaching the ureter and getting low down in the pelvis in that direction.

[1] Since this manuscript was completed Miss J. V. has died of general tuberculosis.

Dr. Lewis S. McMurtry, of Louisville.

I should like to ask Dr. Vander Veer to elaborate one point in the technique, and that is the use of the silk ligature. I should like to ask him if in suppurative cases he leaves the ligature long, and as to his method for its removal or whether he buries it?

Dr. Vander Veer. In two of the cases reported I left the ligature long, just as we used to do in amputating a thigh in the early days, and had no reason to regret it. Recently I have cut the ligature short, put in a rubber tube or drainage of gauze, and I have had no reason to regret doing that. The silk has not given any disturbance except in one case, and in this had to remove the ligature later on because it was a continual source of suppuration. After it was removed with a crochet needle the sinus healed immediately.

I wish to refer to an interesting case in which no operation was done, but in which at the present time the diagnosis would be cleared up by segregation of the urine. I saw the patient some eight years ago. An interesting history of renal colic on the left side was given, and patient is said to have suffered for a period of two years. She was well for a period of eight years. She had an attack on the right side of severe pain, was jaundiced on two or three occasions, and was said by one physician to be suffering from biliary colic. Soon after this she began to have pain which extended down the right side; the urine contained oxalate of lime, and there was trouble with the right kidney. I was called to see her with a view to determining whether operation should be done or not for relief. She was in such a weak condition that it was deemed advisable not to operate. We found the left kidney completely atrophied at the postmortem examination which was made, with the upper portion of ureter closed by a calculus. The gall-bladder contained twenty-four biliary calculi. There was an abscess of the right kidney, with four distinct calculi resting in the calices. I simply present this case to illustrate the form of embarrassment had we attempted an operation.

# EXCISION OF PORTIONS OF THE CHEST WALL FOR MALIGNANT TUMORS.

By EMMET RIXFORD, M.D.,
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Malignant growths of the chest wall as seen clinically are chiefly of two classes—carcinomata, secondary to primary tumors of the breast, and sarcomata (including endotheliomata), arising from the ribs, periosteum, skin, pleura, etc.

In these days of radical operation for cancer of the breast which is apt to be performed earlier than formerly, the prognosis is far better than it was a few years ago, but still a considerable proportion of cases exhibit regional recurrences in spite of most radical work. These occur frequently in the chest wall itself and at various points along the path of the lymphatics leading from the mammary gland. Such recurrences may form anywhere along the inner side of the ribs or make a chain of nodules reaching to the spinal column, but are more common at the inner ends of the ribs or more accurately the intercostal spaces where the branches of the internal mammary artery perforate the chest wall, presumably because of the passage here of numerous lymphatics on their way to the mediastinal glands. In two of the cases here reported the local recurrence was in a lymph gland situated in the intercostal space at its inner end.

In a number of instances the writer has seen such local recurrences after radical removal of tumors which had not yet become attached to the chest wall but were still freely movable, and also in cases where the primary tumor was in distant portions of the breast. It would seem that lymphatic infection at the edge of the sternum is comparable in frequency to that of the axillary glands, which would suggest the systematic removal of all subcutaneous tissues in that region down to the perichondrium in all

cases of carcinoma of the breast whether the tumor be in the internal or external portions of the mammary gland.

In a certain proportion of cases these recurrences are local when discovered and may be successfully removed. The removal, however, requires resection of considerable areas of the chest wall, including all of its structures and entails opening of the pleural cavity on that side, together with plastic closure of the defect.

It may be stated more broadly that regional recurrence after radical operation for carcinoma of the breast is very apt to involve the chest wall, and if such a tumor is to be successfully removed the underlying portions of the chest wall must be removed with it. This follows because in the modern radical operation for carcinoma of the breast practically all the subcutaneous tissues are removed from the whole breast area down to the periosteum and intercostal muscles, and any recurrent nodule growing beneath the skin may be considered to have invaded the intercostal muscles by the time it has become large enough to be detected. This is quite as true where the recurrence is the result of scattering of cancer cells in the connective-tissue spaces as in purely lymphatic recurrence. Lenticular skin metastases are in their beginnings an exception to this rule.

Mr. Jacobson advises operation in such cases, which he says may be done with the expectation of at least delaying general infection with the disease. He reports one case, however, in which the patient was free from recurrence two years after the resection of the chest wall.

Sarcoma of the chest wall may arise in any of the structures from the skin to the pleura, but the more common varieties grow from the ribs or their cartilages or the periosteum. The operative relations of sarcoma are not materially different from those of carcinoma, save for the fact that some of the varieties are encapsulated. Infiltrating sarcomata require the widest and most radical removal, while the encapsulated tumors, and particularly the desmoids and the giant-celled sarcomata and often the endotheliomata may be enucleated. Still, even here the section should be made well outside the capsule, since such capsules are themselves often infiltrated.

The following statement of the technique to be employed in such cases is based upon the experience obtained in the cases here reported:

A wide skin incision is made of such shape as to be readily closed by some simple plastic procedure. A curvilinear triangle answers admirably.

The chest is then opened through an intercostal space at some distance from the tumor sufficiently to permit of exploration of the inner surface of the ribs in the neighborhood of the tumor. By this means much can be learned of the extent of the growth and the presence or absence of involvement of the lung or pericardium. This will determine the area of chest wall to be removed. Of course, it is of the greatest importance to take out the tumor in one piece without section of tumor tissue, but in some cases this may not be possible.

The ribs are first cut on the outer side—*i. e.*, the side of greater fixation, preferably without cutting the pleura. By this means the intercostal arteries can be most readily caught by means of a curved needle carrying a catgut ligature. Further advantage lies in the fact that if the pleuroperiosteal section be made a little nearer the tumor than the bone section the flap of periosteum and pleura will offer some protection to the lung from the sharp edges of the ribs.

In these cases there were no untoward symptoms incident to the production of pneumothorax. It was noticed, of course, that the respiration became immediately deeper and more rapid as soon as air entered the pleural cavity, but aside from the violent flopping of the heart from right to left, terrifying to look at but without noticeable effect on the pulse, there was no special inconvenience to patient or operator. This is quite in accord with the statement of Dr. Park[1] that one side of the chest may be operated upon without resort to artificial respiration and with the work of other surgeons. A notable operation by Koenig, quoted by Park, might be mentioned. Trzebicky,[2] in 1902, reported five extensive operations on the chest wall for the removal of tumors done without artificial respiration. This statement may be worthy of

[1] Annals of Surgery, 1887.

[2] Arch. f. klin. Chir., 1902, vol. lxvii.

reiteration in view of the numerous apparatuses which have been devised to overcome the effects of the artificial pneumothorax. Doubtless Fell's apparatus and the Sauerbruch cabinet are of value in special cases, the latter essential in cases where there is likelihood of both sides of the chest being opened, but resection of the chest wall in the usual case can be done satisfactorily without these appliances. Dr. Keen reported a case in which he had removed a large sarcoma of the chest wall, and when the chest was opened he had tried to use Fell's apparatus without tracheotomy. The apparatus did not fit the face well and was discarded and the operation completed without the occurrence of serious symptoms. The idea of Delagenierre that the chief danger in operative pneumothorax lies in the suddenness of its production (which led Dollinger to the establishment of an artificial pneumothorax under local anæsthesia twenty-four hours or so before performing an operation on the chest wall) is probably of considerable meaning and worthy of serious consideration. Probably, however, most of the advantages of Delagenierre's principle can be obtained during the anæsthesia by allowing the air to enter the pleural cavity only slowly, giving the system reasonable time to accommodate itself to the new conditions.

In the cases here reported the writer found that the respiration could be greatly modified and the tremendous lateral excursions of the heart and mediastinal tissues almost completely checked by the simple procedure of stopping up the opening in the chest wall with a wet towel. The towel folded into two or three thicknesses is made to slip beneath the partially loosened section of chest wall, which is to be removed and is drawn forward as new cuts are made. It is important to close the opening at the moment of complete expiration when the chest is largely emptied of air. When this was done the lung expanded and the exaggerated and fatiguing respiratory efforts were at once quieted. When by gradual leakage a considerable amount of air had accumulated in the cavity the towel was readjusted and closure made again at the moment of complete expiration.

In those cases where the tumor was at the edge of the sternum it was found convenient after cutting the ribs to raise the tumor to the inner side, bending the costal cartilages to permit of work

beneath. The internal mammary artery was readily caught above and below by passing about it a curved needle armed with catgut and was tied before being cut. The section of the sternum was made with bone shears and included about half its width.

Removal of the tumor in several cases gave excellent exposure of the upper pericardium and of the mediastinum which in one or two cases showed enlarged glands which were readily removed with the surrounding fatty tissue.

The wounds were closed in each instance by a large skin flap lifted up from some convenient region, generally the upper abdomen, where the laxity of the skin permits ready closure of the defect. In one case a flap was taken from the opposite side of the chest, the very full breast being held toward the median line with adhesive plaster; this with reference to Dr. Richardson's notion of using the opposite breast to assist in closing the large wound left by the radical operation for carcinoma of the breast. The amount of air left within the chest was made much less by letting it out during expiration and preventing its re-entrance by means of the closing flap, which to this end should be made somewhat larger than the opening in the chest wall. Absorption of the air was rapid, so that in a few days the remaining pneumothorax was not demonstrable.

It was feared that the aspirating action of the lower pressure on the raw inner surface of the occluding skin flap would cause exudation in embarrassing amounts into the pleural cavity. This did not occur, however, unless in one case where a dulness was made out within a few days, but in this case there must have been some degree of infection as the patient had a temperature of 100° to 103° for a week, and aspiration failed to demonstrate fluid, probably a localized pneumonic process with pleurisy.

In all of the cases the respiration remained more rapid than normally for a week or more, for which I think the soreness incident to the movements of the ends of the ribs in the unhealed wound is quite as accountable as the remnant of pneumothorax.

The final condition of the wounds was satisfactory in all of the cases. Widespread but weblike adhesions were sufficient to prevent collapse of the lung in one case where a second operation was performed.

I would report 5 cases of resection of the chest wall for recurrent carcinoma of the breast in four patients and one of removal of the clavicle and first rib and portion of the sternum for sarcoma which in point of operative technique presented a number of similar conditions.

Case I. *Recurrent carcinoma of breast over fifth rib; resection of fourth and fifth ribs; no evidence of recurrence after two years.*—(Reported by courtesy of Dr. Stanley Stillman, of San Francisco.) Miss C. had been operated upon in 1899 at the age of twenty-seven years, by Dr. Lund, of Boston, for carcinoma of the right breast. In 1900 a recurrence in the scar was removed by Dr. Lund, and in 1901 in San Francisco the patient presented a hard, flat, immovable tumor about 5 cm. in diameter, situated over the fifth rib just outside the epiphysis; *x*-ray treatment was used three times a week for eighteen months. For a time the tumor grew smaller, then it began to increase in size and radical removal was determined upon. In July, 1905, Dr. Stillman removed some 5 cm. of the fourth and fifth ribs with the adjoining intercostal tissues. Though the tumor projected through the chest wall there were no adhesions to the lung and no mediastinal tumor was made out. The opening was closed by a skin flap lifted up from the abdominal wall. Recovery was rapid and uneventful. Patient was seen July 1, 1905, two years after operation and showed no evidence of recurrence but was in perfect health.

Case II. *Recurrent carcinoma of breast at edge of sternum; resection of fourth and fifth costal cartilages with edge of sternum; recurrence in mediastinum after eight months; disappearing under x-ray but reappearing five months later.*—Mrs. W., aged sixty-six years, had been operated upon by the Halsted method in January, 1902, for carcinoma in the outer upper quadrant of the right breast, which had been noticed for a year and which had begun to invade the skin and had produced a large axillary tumor. In the operation everything had been removed from the edge of the latissimus dorsi to the sternum, and from the first rib to the tenth. The skin wound was so wide as to require the use of swinging flaps to effect closure. In November, 1903, twenty-two months later, the patient returned with recurrent tumor in the scar at the edge of the sternum over the fifth costal cartilage, 2 x 3 x 1.5 cm.

in diameter, sharply outlined but fixed. There was no evidence of axillary or other recurrence, and the patient being in good physical condition it was determined to remove that portion of the chest wall carrying the tumor. A curvilinear triangular incision 7 cm. on each leg was made and a skin flap lifted up from the upper abdominal wall sufficient to close this defect. The pleura was opened enough to admit the finger, which showed that the tumor was of about the same size on the inner surface of the ribs as on the outer but did not involve the lung. An area of chest wall about 7 cm. in diameter was removed as described above. During much of the dissection the pleural opening was closed more or less perfectly by the hand of an assistant or by a wet towel by which the respirations were kept quiet and but little deeper or faster than the normal. The skin flap was stitched in place over the opening with silkgut sutures and the edges accurately approximated with catgut. Before sealing the wound a pair of forceps was introduced between the stitches and the greater part of the air let out of the chest, the forceps being quickly withdrawn at the end of expiration. Immediately after the operation the respirations were 22, but as patient regained consciousness they increased to 40, probably as a result of soreness. On the second day they were 28 and remained at 30 for several days. On the eighth day the wound was dressed for the first time; it had healed by primary union save for slight redness of the wound edges, and on the eleventh day the stitches were removed, the patient leaving hospital on the nineteenth day. On the sixteenth day a few drops of pus appeared in the abdominal portion of the incision.

In September, 1904, patient returned showing two pea-sized recurrent nodules beneath the skin in the mediastinum. Further operation was deemed useless and patient was referred to the *x*-ray department of Lane Hospital for treatment. After twenty treatments by Dr. Lehmann during eight weeks the nodules were no longer palpable, and patient returned home. In February, five months later, I was informed by letter that one of the nodules had begun to enlarge again, and that patient was very weak, probably from internal metastases.[1]

[1] Died of cerebral hemorrhage, August, 1905.

CASE III. *Recurrent carcinoma of breast at edge of sternum; resection of third and fourth costal cartilages with half of breadth of sternum; recurrence in original scar apart from field of last operation; pleural carcinoma; death from general carcinosis five months later.*—Mrs. D., aged forty-five years, was operated on in February, 1903, by Halsted's method for a large spherical, rapidly growing carcinoma of the left breast with large axillary tumor; patient was very fat and had noticed the growth only five months before. In July careful examination failed to show any recurrence. In November several small nodules were discovered in the lower anterior part of the scar and were excised. The dissection going only to the periosteum.

In March, 1904, two other recurrent nodules were found at the border of the sternum in the original skin, the flap of the last operation remaining free. As in Case II., the region about these nodules, 12 cm. in diameter, was excised. One of the nodules was seen to penetrate into the fourth intercostal space. The patient being in good condition, the pleura was opened through an intercostal space nearby and the inner surface of the wall examined with the finger. The tumor did not appear to have penetrated to the pleura and the lung was free, but an enlarged gland was detected at the edge of the mediastinum.

The fourth and fifth costal cartilages were then cut away, the internal mammary artery tied and cut and a section of the sternum 1.5 x 5 cm. removed. A second enlarged gland in the mediastinum was removed with the fatty tissue about it. Because of the retraction of the lung a large area of the chest wall was exposed to view, but no further recurrences were evident. After operation the pulse was 96 and respiration 30, but patient complained of very great pain. For the next week there was considerable fever; temperature, 99° to 103°; pulse, 90 to 110, with a good deal of pain, evidently a septic pleurisy or superficial pneumonic process. On the fourth day patient was more comfortable and sat up in bed. Some dulness was detected, presumably from effusion. On the eleventh day stitches were removed and a small abscess evacuated in the abdominal part of the incision. On the eighteenth day patient left hospital; respiration still 30, pulse 110. In May, two months later, patient returned with small recurrence external to last opera-

tion, and with wide dulness over left chest. Several punctures with needle brought no fluid, the dull area being probably caused by pleural carcinoma, further operation was out of the question. Patient died in July, four months after the resection of the chest wall and seventeen months after the Halsted operation, twenty-two months after patient first noticed the tumor.

Case IV. *Recurrent carcinoma of breast at edge of sternum; inner ends of first and second ribs and portion of sternum and mediastinal glands removed; internal mammary artery tied at its origin; further recurrence below; resection of third and fourth ribs; patient well six months after last operation, twenty-two months after Halsted operation.*—Mrs. M., aged fifty-three years, was operated on by Halsted's method in August, 1903, for a large suppurating carcinoma of the upper outer quadrant of the left breast with large axillary tumor. Patient was very fat; had noticed the tumor but four months before. This had been incised by the family physician for infection, suppuration continuing and tumor growing out of the incision. After the operation much of the flaps used to close the incision about the drainage tubes sloughed and the resulting raw surface was so large as to require the application of Thiersch grafts, which was done as soon as the suppuration permitted. In August, a year later, patient returned with recurrence 3 cm. in diameter at the edge of the sternum, over the second intercostal cartilage. The tumor was widely circumscribed, the second rib cut across, opening the pleura 5 or 6 cm. external to the border of the sternum and the internal mammary artery secured by double ligatures in the second intercostal space and divided between. The first rib was then similarly cut and the sternum divided with bone forceps from below nearly in the middle line and as far as the level of the sternoclavicular joint. The mass was then turned upward to give access to the upper portion of the internal mammary artery, but it was not found practicable to secure the artery as high up as was desired, so it was caught in forceps in the first interspace and freed from the first rib. The tumor mass with first and second ribs, portion of sternum and sternoclavicular joint were removed. It was then a simple matter to tie the internal mammary artery well above the position of the first rib and to remove the pleura and other

tissues which had been in proximity to the tumor. The wound was closed with a large flap lifted up from the right side of the chest.

The patient was somewhat cyanotic during the early part of the operation (patient was very fat and had her chest cavity still further compressed by abdominal fat), but the pulse remained strong and regular. Through a considerable part of the operation the pleural cavity was well enough closed with a wet towel to permit of considerable expansion of the left lung, and when the towel was used the respiration was markedly quieter and approximated the normal.

After the operation the pulse was 82 to 100 and the respiration about 30. Primary union occurred and patient left hospital on the twentieth day. In the following November patient returned but showed no evidence of recurrence. She was strong and well and able to do hard work. In January a small nodule was found at the edge of the sternum in the third intercostal space. A second resection of the chest wall was therefore done, since there was no sign of other recurrence, in which the third and fourth ribs and edge of sternum were removed. Gauzy but widespread adhesions of the lung to the parietal pleura prevented collapse of the lung, so that the operation was much simpler than the previous one. It was interesting to note the demonstration of the portion of the heart which is uncovered by pleura, for this was beautifully shown when in expiration the lung being confined by adhesions, bellied forward all around this area. At the present time, six months after the last operation and twenty-two months after the Halsted operation, patient is well and strong and shows no sign of recurrence.[1]

Case V. *Sarcoma of clavicle involving first rib and sternum, with large mediastinal tumor; resection; recovery; patient being well and strong at the present time, eleven months after operation.*— W. H. H., aged seventy years, teamster, presented a large tumor

[1] September, 1905, recurrence on right side of sternum; excision of tumor, with second, third, and fourth costal cartilages, the whole of the sternum to the insertion of the fifth rib, and a mediastinal tumor the size of a walnut. No untoward symptoms due to opening of the chest. Primary union; patient out of bed on tenth day.

at the base of the neck on the left side, fixed to and probably originating in the clavicle. Two years before he had injured the collar bone and three or four months afterward noticed a small tumor near the inner end of the clavicle. The tumor continued to enlarge until it reached the size of about 10 x 15 x 8 cm., the long diameter being vertical. It covered the sternoclavicular joint and extended well up on the neck and over the upper chest. The skin contained many dilated veins but was movable over the tumor which was smooth in general outline, though coarsely lobed. Patient's general physical condition was excellent.

On August 16, 1904, under chloroform, the skin was incised, the edge stripped back and the clavicle exposed and cut at the junction of its middle and outer third. The greater pectoral was cut across and the sternocleidomastoid divided about its middle. The clavicle was then tilted upward and the subclavius muscle divided. The first rib was then cut at a point internal to the subclavian vein without opening the pleura, the first intercostal muscles cut, and the whole mass turned inward. A large lobe of the tumor the size of a hen's egg projected beneath the sternoclavicular joint into the mediastinum. In dissecting the subclavian vein from the tumor it was punctured near its point of union with the internal jugular. A little air entered, but compression with a gauze pledget sufficed to close the opening during the dissection. In order to complete the separation of the vessels from the under side of the tumor the ligated external jugular was used as a guide and answered admirably. The internal mammary artery was not adherent to the tumor, but was lifted off it with the parietal pleura.

Because of the great depth to which the mediastinal lobe of the tumor extended, the uncertainty as to the quantity and character of adhesions of this lobe to the important structures of the mediastinum, and the great difficulty of dissecting beneath so large a tumor made it impracticable to complete the operation without dividing the tumor. Accordingly the greater mass of the tumor was torn across and then section of the sternum was made with bone shears. The remainder of the tumor was then removed without difficulty.

While the pleura was not opened in this operation the upper

portion of the pleural sac was so widely freed from its parietal attachments that there was almost as much interference with the respiration as if the pleura had been opened, and the bulging of the pleura into the wound with every expiration was annoying.

Whenever the pressure on the subclavian vein was released air would enter, and this occurred four or five times, but the quantity was small and it seemed to make no difference with the patient's breathing or pulse. The opening was finally closed with fine silk suture and fortified by a flap of fascia stitched over the suture line. The thoracic duct was not injured as it probably would have been had not the external jugular been used as a guide and all the dissection carried on in front of it.

The wound was closed with drainage. Patient made a rapid recovery, being out of bed on the seventh day and leaving the hospital on the twelfth day.

At the present time (July 1st, eleven months after operation) patient is continuing at his work as teamster, and his physician writes that he is well, having withstood an attack of la grippe, which tried his lung and shoulder severely in the coughing. There is no sign of recurrence as yet. Histologically, the tumor was an endothelioma.

In recapitulation, the writer would hazard the opinion that although, to quote Watson Cheyne, "the patient's chance is in the first operation," there is still some hope for a certain proportion of cases with recurrence in sufficiently radical resection of the chest wall. Recurrences of the sort indicated are apt to be developed from remnants of the original tumor and may in themselves be purely local. Radical dissection of the axilla is frequently followed by freedom of recurrence in that region because of the interruption of the process of metastasis by the lymph glands. May not, in certain cases, the same thing be true of removal of infected lymph glands of the chest wall and anterior mediastinum?

The artificial pneumothorax, if unilateral, presents no dangers sufficient to constitute contraindication to the operation in patients well enough otherwise to warrant operation. The fatiguing respiratory efforts which supervene when the chest is opened

may be almost entirely done away with by the use of a wet towel, covering the opening during the dissection.

As for results it may be stated that of the six operations (including that of the sarcoma) there was no mortality, although most of the patients were well along in years. The ages at the time of the resections being forty, forty-six, fifty-four, sixty-eight, and seventy, with average of fifty-five, and all except the sarcoma case having undergone radical Halsted operation, three cases within a year, the fourth within two years.

Of the four cases of recurrent carcinoma, one is dead four months after the operation (the tumor in this case was one of more than ordinary malignancy and rapidity of growth); one had further recurrence in the mediastinum after eight months, which disappeared under the *x*-ray but reappeared five months later, though the patient is still living twenty months after the operation and twenty-eight months after the original Halsted operation; one had further recurrence in the next lower intercostal space for which a second resection was done in January last, and is at present, six months later, free from recurrence, eleven months after the first resection and twenty-two months after the Halsted operation; and finally, one is free from recurrence two years since the resection. (Case of Dr. Stillman.)

It is fair to state that in all but one of these cases life has been prolonged, but it is still too soon, of course, to say whether any of the three cases which are to-day free from recurrence will remain so.

## DISCUSSION.

Dr. N. B. Carson, of St. Louis.

In connection with Dr. Rixford's paper, I wish to report two interesting cases, one of osteosarcoma, the result of recurrence after removal of the male breast. The patient was thirty-seven years of age, and presented himself with a tumor about the size of a fist, having its origin from the fifth and sixth ribs. I made an incision through the skin some distance from the tumor, dissected this free, and then, uncovering the ribs, I opened them from the outer side. I did not follow the plan recommended by Dr. Rixford, of avoiding the pleura; knowing this was involved, I opened the pleura immediately, and after having first cleared the wound thoroughly, resected the ribs with the tumor, removing an area of about six inches or more. I was not as fortunate in this case as Dr. Rixford was in some of his, because we soon had a recurrence, not only at the site of the tumor, but in the scalp and in other parts of the body; so that we had general sarcoma following the removal in this case. The patient lived almost a year, and then died.

The second case was a child upon whom I operated a year ago last June for a tumor (osteosarcoma) of the sternum. The middle portion of the sternum was involved by the tumor, and it bent forward, making the tumor appear much larger than it really was. I removed parts of three or four ribs with all of the sternum except the manubrium. The patient made a good recovery, and at last accounts was still well.

In the first case, upon opening the pleura, we had, as Dr. Rixford stated, a marked increase in respiration; otherwise there was no trouble, and I made no effort to let out the air.

In the second case the child suffered considerably after the removal of the sternum with the ribs by the flapping to and fro of the pericardium, which was not opened. But this subsided, and the only disagreeable symptom was that every time the dressings were changed there was trouble from the flapping backward and forward of the pericardium. I have had no experience with the pneumatic cabinet.

Dr. Roswell Park, of Buffalo.

As the essayist has alluded to the pneumatic cabinet, I would like to add a little of my own experience with it. We have one in Buffalo; I have experimented with it, more or less, but not on human patients. Sauerbrook came from Mikulicz's clinic to Berlin, last year, to demon-

strate its use, and I saw the demonstration. This cabinet has a reversible arrangement, so that one can have the patient inside, with the operator, patient's head and anæsthetizer outside, in which case the air pressure is reduced by about twelve millimetres, or five thousand feet of elevation; or the other way, with the anæsthetizer and patient's head in the cabinet, and the operator and his assistants outside, with an increased pressure, which is not so efficacious, but more convenient.

I have watched the results obtained in the laboratories by ordinary means, and have not been able to convince myself that this method is superior, and I have not been willing to try it on the human being as yet. A large experience in opening the chest and heart in animals, and in a number of human cases, leads me to agree with Dr. Rixford, that it is unnecessary to have elaborate assistance in order to successfully open one side of the chest in order to do anything we need to do. I think it is possible to do one of the long transdiaphragmatic operations, making an anastomosis between the œsophagus and stomach through the diaphragm, as a mechanical feat, but whether it is justifiable as a surgical operation is another question.

I am very glad to hear the result of the experience of the essayist, and to hear him announce as he did, that it is possible, feasible, practicable and even humane to do this sort of operation, when it needs to be done, without the necessity for any such elaborate architectural assistance as is afforded by the pneumatic cabinet.

Dr. F. W. Parham, of New Orleans.

I wish to bear testimony to the experience of Dr. Rixford that the pneumatic apparatus is not an absolute necessity. I have previously published two cases of resection of the chest wall for tumors; one died a year later from recurrence and pneumonia; a second, in which I carried out the plan of artificial respiration with the Fell-O'Dwyer apparatus, with foot leverage to work the bellows, the O'Dwyer cannula being introduced into the larynx. That patient is now alive, seven years after operation, and is one of the carriers in the Charity Hospital, New Orleans. In this case the artificial respiration was beautifully maintained and was of material assistance in the operation.

The third case I operated on a little over a year ago, in which I attempted to carry out the same procedure, using the Fell-O'Dwyer apparatus. This case has not as yet been published. I found in that case it was impossible to retain the cannula in the larynx; the reflex heaving of the diaphragm producing such irregular motion, such violent efforts at gagging, etc., that made it impossible to keep the cannula in, although it was managed by one of our skilled laryngologists. I removed

the cannula and did a chest operation which involved the resection of the tenth, eleventh, and twelfth ribs, leaving only a small portion of the anterior and posterior ends, running back nearly to the angles of the ribs. The diaphragm was not involved, but was considerably crippled by the removal of the lower ribs, and I had considerable difficulty in closing the wound. Finally, I brought the lung down and stitched it to the diaphragm, spreading it out like a piece of leather, with large cavity behind, closed the wound, drew the skin which had been opened by a crucial incision together with sutures, having absolutely nothing but skin to cover the wound. The patient, although at times in great jeopardy, recovered from the operation, and is to-day, fourteen months after the operation, alive, without recurrence, with about eight months' irregular treatment with *x*-ray applications.

I would like to say, as the result of my experience in these cases, that whilst I do not feel that I can say the Fell-O'Dwyer apparatus ought to be given up by any means, because I believe in many instances it will afford very material assistance in the treatment of artificial pneumothorax where the opening is to be made very large, I do believe the importance of artificial respiration has been exaggerated, and I certainly see no necessity for such a complicated apparatus as Dr. Park has referred to—the pneumatic cabinet.

With regard to air in the pleural cavity, that may be practically disregarded. If anyone fears, however, that the air will do harm, it is a good plan to carry out the suggestion made by Witzel, of filling the chest cavity with a weak solution of boracic acid, letting it out through the catheter or tube as the wound is closed. In that way with fluid pressure it may be easy to get all the air out.

Dr. Rixford. In the first place, I want to say that I have heard of Dr. Parham's work in this field, but have not had the opportunity of reading his original article.

As for the present results in these cases I would say that following the five operations there was no mortality. Three of the four patients are still living; one has recurrence. Two are free from recurrence, and one of these (Dr. Stillman's case) is free from recurrence at the end of two years.

# A SUMMARY OF ALL THE CASES OF FRACTURE OF THE SPINE (244) WHICH WERE TREATED AT THE BOSTON CITY HOSPITAL FROM 1864 TO 1905.

By HERBERT L. BURRELL, M.D.,
BOSTON.

*Is the spinal cord irremediably damaged?* This is the question that immediately arises in the mind of a surgeon when he first sees a patient with a fracture of the spine. The utter hopelessness of the condition, when there is complete destruction of the cord, is universally accepted.

*Can we tell whether a spinal cord is irremediably damaged or not?* On the answer to this question depends in many cases whether or not an operation should be done.

In many cases it is perfectly clear that the cord is crushed. In other cases doubt exists as to whether the cord is irremediably damaged. In still other cases it is a fair presumption that the cord is not hopelessly damaged.

These questions are constantly presenting themselves to surgeons, and it is often impossible to answer them dogmatically in an individual case.

Prior to 1887 the expectant treatment of fractures of the spine was practically always used. The mortality was so large and the suffering so distressing that it led me to advocate immediate rectification of the spine and its fixation by a plaster-of-Paris jacket.[1]

Open operations on the spine were done occasionally from the time when Henry Cline operated at St. Thomas' Hospital in 1814,

[1] Fracture of the Spine: Its Immediate Treatment by Rectification of the Deformity and Fixation by Plaster-of-Paris Jacket. Medical Communications of the Massachusetts Medical Society, vol. xiv., No. 1, June 7, 1887, p. 151.

up to the advent of antisepsis, but all these operations were futile or followed by a fatal ending.

Antisepsis and a simple method of doing laminectomy have rendered it possible to open the spinal canal and to look at the cord. An open operation gives definite information as to the condition of the cord and, above all, allows pressure to be removed. Naturally an open operation quickly superseded immediate rectification, which was at best a "hit-or-miss" method of relieving pressure on the cord.

The largest collection of fractures of the spine was made by Gurlt,[1] who reported 270 cases. Thorburn's[2] well-known work is of great value. Morton[3] considered the subject carefully. Lloyd[4] presented 227 cases and judiciously summarized the subject.

The writer, through the courtesy of his colleagues, has twice reported the fractures of the spine at the Boston City Hospital. The first series (82 cases) was published in the *Medical Communications of the Massachusetts Medical Society*, 1887, vol. xiv., No. 1, p. 151. The second series (168 cases, which included the first series of 82 cases) was presented to the British Medical Society in August, 1894, and abstracts of the paper were published in the *Medical Press and Circular*, London, August 29, 1894; in the *British Medical Journal*, August, 1894, and in the *Annals of Surgery*, February, 1895.

The writer now presents a third series of 244 cases, which includes the two previous series. The details of the 244 cases are not presented, but a summary of the three series of cases is given, and a comparison of the different series is interesting and instructive.

These tables show the frequency of symptoms, the deaths and recoveries in the different regions, the mortality, the duration of

[1] Handbuch der Lehre von dem Kurchenbruchen, Hamm., 1864.

[2] Contribution to the Surgery of the Spinal Cord, London, 1889; Manchester Medical Chronicle, 1892, vol. xvi. p. 73; British Medical Journal, 1894, vol. i. p. 1346.

[3] The Practitioner, 1901, vol. lxvii. p. 307.

[4] Philadelphia Medical Journal, February 15, 22, 1902, pp. 336, 374; or Journal of the American Medical Association, 1901, pp. 1014, 1111, 1247.

life in the fatal cases, and the results as to whether the patient is useful or useless in the recoveries.

FIRST SERIES, 1864–87.

FREQUENCY OF SYMPTOMS.

Total cases, 82.

| | | |
|---|---|---|
| Crepitus | 51 = 62.1 | per cent |
| Deformity | 63 = 76.8 | " |
| Unconsciousness | 18 = 21.9 | " |
| Paralysis, complete | 67 = 81.7 | " |
| Paralysis, incomplete | 6 = 7.3 | " |
| Paralysis, none | 0 | |
| Pain | 71 = 86.5 | " |
| Priapism | 18 = 21.9 | " |
| Delirium | 12 = 14.6 | " |
| Cystitis | 31 = 37.8 | " |
| Bed-sores | 27 = 32.9 | " |

REGIONS.

Total cases, 82.

| | | | | |
|---|---|---|---|---|
| Cervical | 28 = 34.1 per cent. | Deaths, | 25 = 89.2 | per cent. |
| | | Recoveries, | 3 = 10.8 | " |
| Upper dorsal | 12 = 14.6 " | Deaths, | 8 = 66.6 | " |
| | | Recoveries, | 4 = 33.4 | " |
| Lower dorsal | 19 = 23.1 " | Deaths, | 18 = 94.7 | " |
| | | Recoveries, | 1 = 5.3 | " |
| Lumbar | 23 = 28.0 " | Deaths, | 13 = 56.5 | " |
| | | Recoveries, | 10 = 43.5 | " |

MORTALITY.

Total cases, 82.

| | | |
|---|---|---|
| Deaths | 64 = 78 | per cent. |
| Recoveries | 18 = 22 | " |

TIME.

Total cases, 82.

| | | |
|---|---|---|
| Total deaths | 64 = 78.0 | per cent. |
| Within five days | 39 = 60.9 | " |
| Within ten days | 8 = 12.6 | " |
| Within one month | 7 = 10.9 | " |
| After one month | 10 = 15.6 | " |

RESULTS.

Total cases, 82.

| | | |
|---|---|---|
| Total recoveries | 18 = 22 | per cent. |
| Useful | 9 = 50 | " |
| Useless | 9 = 50 | " |

## SECOND SERIES, 1887–1900.

### Frequency of Symptoms.

Total cases, 114.

| | | |
|---|---|---|
| Crepitus | 30 = 26.3 | per cent. |
| Deformity | 58 = 50.8 | " |
| Unconsciousness | 14 = 12.2 | " |
| Paralysis, complete | 93 = 81.5 | " |
| Paralysis, partial | 14 = 12.2 | " |
| Paralysis, none | 7 = 5.1 | " |
| Pain | 58 = 50.8 | " |
| Priapism | 37 = 32.4 | " (106 male cases). |
| Delirium | 29 = 25.4 | " |
| Cystitis | 22 = 19.3 | " |
| Bed-sores | 23 = 20.1 | " |

### Regions.

Total cases, 114

| | | | | | |
|---|---|---|---|---|---|
| Cervical | 44 = 38.5 | per cent | Deaths, | 41 = 93.1 | per cent. |
| | | | Recoveries, | 3 = 6.9 | " |
| Upper dorsal | 24 = 21.0 | " | Deaths, | 22 = 91.6 | " |
| | | | Recoveries, | 2 = 8.4 | " |
| Lower dorsal | 34 = 29.8 | " | Deaths, | 19 = 55.8 | " |
| | | | Recoveries, | 15 = 44.2 | " |
| Lumbar | 12 = 10.5 | " | Deaths, | 7 = 58.3 | " |
| | | | Recoveries, | 5 = 41.7 | " |

### Mortality.

Total cases, 114.

| | | |
|---|---|---|
| Deaths | 89 = 78 | per cent. |
| Recoveries | 25 = 22 | " |

### Time.

Total cases, 114.

| | | |
|---|---|---|
| Total deaths | 89 = 78.0 | per cent. |
| Within five days | 67 = 75.2 | " |
| Within ten days | 7 = 7.8 | " |
| Within one month | 8 = 9.2 | " |
| After one month | 7 = 7.8 | " |

### Results.

Total cases, 114.

| | | |
|---|---|---|
| Total recoveries | 25 = 22 | per cent. |
| Useful | 15 = 60 | " |
| Useless | 10 = 40 | " |

## THIRD SERIES, 1900–1904.

### Frequency of Symptoms.

Total cases, 48.

| | | |
|---|---|---|
| Crepitus | 12 = 25.0 per cent. | |
| Deformity | 37 = 77.0 " | |
| Unconsciousness | 9 = 18.7 " | |
| Paralysis, complete | 25 = 52.0 " | |
| Paralysis, partial | 7 = 14.5 " | |
| Paralysis, none | 16 = 33.3 " | |
| Pain | 42 = 87.5 " | |
| Priapism | 11 = 23.9 " | (46 male cases). |
| Delirium | 2 = 4.1 " | |
| Cystitis | 13 = 27.0 " | |
| Bed-sores | 13 = 27.0 " | |

### Regions.

Total cases, 48.

| | | | |
|---|---|---|---|
| Cervical | 14 = 29.1 per cent. | Deaths, | 11 = 78.5 per cent. |
| | | Recoveries, | 3 = 21.5 " |
| Upper dorsal | 7 = 14.5 " | Deaths, | 3 = 42.8 " |
| | | Recoveries, | 4 = 57.2 " |
| Lower dorsal | 22 = 45.8 " | Deaths, | 4 = 18.1 " |
| | | Recoveries, | 18 = 81.9 " |
| Lumbar | 5 = 10.4 " | Deaths, | 0 |
| | | Recoveries, | 5 = 100.0 " |

### Mortality.

Total cases, 48.

| | |
|---|---|
| Deaths | 18 = 37.5 per cent. |
| Recoveries | 30 = 62.5 " |

### Time.

Total cases, 48.

| | |
|---|---|
| Total deaths | 18 = 37.5 per cent. |
| Within five days | 11 = 61.1 " |
| Within ten days | 1 = 5.5 " |
| Within one month | 3 = 16.7 " |
| After one month | 3 = 16.7 " |

### Results.

Total cases, 48.

| | |
|---|---|
| Total recoveries | 30 = 62.5 per cent. |
| Useful | 23 = 76.6 " |
| Useless | 7 = 33.4 " |

## SUMMARY OF THREE SERIES.

FREQUENCY OF SYMPTOMS.

Total cases, 244.

| | |
|---|---|
| Crepitus | 93 = 37.8 per cent. |
| Deformity | 159 = 68.1 " |
| Unconsciousness | 41 = 17.6 " |
| Paralysis, complete | 185 = 71.7 " |
| Paralysis, partial | 27 = 11.3 " |
| Paralysis, none | 16 = 11.1 " |
| Pain | 171 = 74.8 " |
| Priapism | 66 |
| Delirium | 43 = 14.7 " |
| Cystitis | 66 = 28.0 " |
| Bed-sores | 63 = 26.6 " |

REGIONS.

Total cases, 244.

| | | | |
|---|---|---|---|
| Cervical | 86 = 33.9 per cent. | Deaths, | 77 = 85.7 per cent |
| | | Recoveries, | 9 = 14.3 " |
| Upper dorsal | 43 = 16.7 " | Deaths, | 37 = 76.7 " |
| | | Recoveries, | 10 = 23.3 " |
| Lower dorsal | 75 = 32.9 " | Deaths, | 41 = 56.1 " |
| | | Recoveries, | 34 = 43.9 " |
| Lumbar | 40 = 16.3 " | Deaths, | 20 = 50.0 " |
| | | Recoveries, | 20 = 50.0 " |

MORTALITY.

Total cases, 244.

| | |
|---|---|
| Deaths | 171 = 64.5 per cent. |
| Recoveries | 73 = 35.5 " |

TIME.

Total cases, 244.

| | |
|---|---|
| Total deaths | 171 = 64.5 per cent. |
| Within five days | 117 = 65.7 " |
| Within ten days | 16 = 8.6 " |
| Within one month | 18 = 12.1 " |
| After one month | 20 = 13.3 " |

RESULTS.

Total cases, 244.

| | |
|---|---|
| Total recoveries | 73 = 35.5 per cent. |
| Useful | 47 = 62.2 " |
| Useless | 26 = 37.8 " |

The writer recognizes that statistics may be very deceptive and that they may be made to prove almost anything; yet certain generalizations may be drawn from them. The figures speak for themselves, but it should be remembered that the observations and the records were made by a constantly changing staff of surgeons.

I have purposely refrained from drawing deductions from these figures, for I find that Dr. Crandon, who has carefully gone over the records, arrives at one conclusion and I arrive at another. If two individuals can reach different conclusions from an analysis of the same cases it shows clearly the fallacy of attempting to generalize from cases that have been observed and recorded by many different surgeons. For this reason the reader must critically analyze these figures and draw his own conclusions.

The most striking statistics are those of the mortality in the first series when compared with the mortality in the third series. In the first series there was 78 per cent. of deaths; in the third series there was 37.5 per cent. of deaths. This extraordinary difference in mortality is due to the inclusion of fractures of the spine which did not have paralysis in the statistics of the third series. In the first series of cases, if paralysis was not present in some degree, the case was not considered to be a fracture of the spine. For this reason the mortality tables of the summary of the three series cannot be accepted at their face value. Injuries of the spinal column that were formerly considered to be wrenches of the spine are to-day known, in some instances, to be fractures of the spine without cord symptoms. These cases are brought to the hospital with what is thought to be a minor injury and are sooner or later recognized as fractures of the spine. The nursing care of patients has greatly improved, and this has doubtless diminished the mortality.

The three types of cases that I recognize are the following: 1. Cases in which the cord is crushed. 2. Cases in which doubt exists as to whether the cord is irremediably damaged. 3. Cases in which it is fair to assume that the cord is not irremediably damaged.

1. *Cases in Which the Cord is Crushed.* This forms by far the largest class of spinal injuries. I append autopsy reports (for

which I am indebted to the Pathological Department of the Boston City Hospital) of several of the cases to show the mechanics of absolute cord destruction.

(1) Anterior portion of twelfth dorsal vertebra broken into fragments. Largest wedge-shaped, 3 cm. long, entire body pressed backward. Compressed so that intervertebral disks above and below have largely disappeared. Posterior portion of body forms a knuckle-like mass projecting toward cord, elevated over 1 cm. above level of the other vertebræ; on the cord, corresponding to the projection of the posterior surface of the body of the twelfth vertebra, is an area of softening 1 cm. in length. At the lower border is a marked constriction, the anteroposterior diameter of the cord being reduced one-half. This occurs at a point 3.5 cm. above the tip of the conus medullaris. The softened portion is grayish-white and translucent on section.

(2) Arches of spinous processes of first and second dorsal vertebræ absent (operation). Cord at this point appears normal. No blood in spinal canal. On anterior aspect of spinal column fifth cervical projects anteriorly 5 cm. in front of cord, which is dislocated backward. Fourth is freely movable on fifth and also fifth somewhat less degree on sixth. Body of sixth anteriorly is movable with crepitus and spinous processes, with a portion of arch of this same vertebra can also be moved freely from side to side. There is apparently fracture of transverse processes of fifth cervical vertebra.

(3) Examination of spinal column from anterior surface showed transverse fracture of body of seventh cervical vertebra. Small bony fragments projected into adjacent tissue. Arches of sixth and seventh cervical were comminuted. On posterior surface of dura beneath arch of seventh cervical and to less extent beneath that of sixth was a small amount of dark-red, coagulated blood. No hemorrhage within dura. Vessels on surface of cord were injected. Distinct softening of cord opposite point where sixth nerve is given off.

(4) Spines of seventh and eighth dorsal vertebræ not present. Opposite bodies of seventh and eighth, cord is sharply compressed by knuckle from posterior portion of bodies. On opening the dura

the cord was found completely divided, the upper portion being separated from lower by space 4 cm. The torn ends of cord end blindly in mass of fibrinous tissue. Body of eighth dorsal was seen to have been forcibly driven backward and crushed between seventh and ninth dorsal. Lower portion of ninth exhibited old line of fracture, with new formation of bone at about middle of body. No evidence of articular cartilage between eighth and ninth dorsal. Ninth projected into spinal canal at a sharp angle, about 45 degrees. Above angle made by displaced ninth there was a new-growth of bone along front of spinal canal, making angle less prominent.

(5) A sharp knuckle of bone is found pushing into spinal canal anteriorly and corresponding to upper portion of body of first dorsal vertebra. This knuckle represents body of first dorsal. The articular cartilage between first dorsal and seventh cervical having been crushed and ligaments torn, the body of vertebra was forced back, producing angle in canal. Cord over knuckle was found softened and discolored by hemorrhage into it. Microscopically for about 2 cm. above and below there was blood in the posterior horn.

(6) Roughened area in region of first lumbar. Body of twelfth dorsal much narrower on left than on right, bone having been apparently crushed on left side. Irregular fracture body of first lumbar with a fragment projecting posteriorly into spinal canal. Cord degenerated from upper dorsal to cauda equina.

(7) Eighth dorsal vertebra divided by oblique fracture, beginning about middle of body and extending on each side upward and backward through body, pedicles, and laminæ. Cord for about 2 cm. opposite site of fracture is narrowed and completely softened. Cord for about 1 cm. above and below this shows central cavity partially filled with thick, red fluid. This cavity corresponds in form and size with portion of cord usually occupied by gray matter. Fluid contains compound granular cells—irregular nerve fibres.

(8) Upper lumbar displaced to left, dislocation forming marked angle with adjacent dorsal vertebra. Unnatural mobility here. Spines of twelfth dorsal and first lumbar were separated one inch, ligaments torn. Fracture of body of first lumbar. Portion of cord

two inches long over displaced ridge of first lumbar distinctly softened. Over projection the cord was brown and diffluent, completely disorganized.

(9) There was a displacement between second and third dorsal vertebræ, body of the second being forced backward and to the right about one-fourth of an inch. This displacement was more apparent upon examination of spine posteriorly, spines and cord having been removed. Second and third spines were broken at their tips. Cord in this region was overlaid by thin, soft clot, and there was a region of softness one-half inch long, which upon section displayed a considerable effusion of blood into cord. Whole cord at this level was disorganized.

(10) Spinous process of sixth cervical vertebra was broken and there was a separation between the fifth and sixth admitting tip of finger. There was also a separation between bodies of fifth and sixth through intervertebral disks, with rupture of ligament to such a degree as to permit displacement of fifth forward nearly one-fourth of an inch. No free blood in meninges. In immediate relation with vertebral injury, spinal cord shows a mass of softening through one-half of its length, extending through entire thickness. The consistency and color of cord at this point is that of thick cream.

(11) Examination of spinal column anteriorly reveals nothing abnormal. Spinous processes of the fourth and fifth cervical were widely parted and fourth was displaced slightly forward. Fracture through body of fourth and through cartilage below it. Cord at this point was compressed, soft, and red. No blood within dura, compression being wholly due to displacement of fragments.

(12) Abnormal mobility between fifth and sixth cervical, with anterior displacement of fifth to extent of one-fourth of an inch. Fifth and sixth spines separated, following rupture of their ligaments. Fractures of intervertebral disks below fifth, with separation of articular surfaces of transverse processes. Little blood outside dura; within dura, around cord, very little. At point of fracture the cord was shrunken, soft, and red. The extent of the lesion was about three-fourths of an inch.

(13) Anteriorly second lumbar presents fracture through its body. Considerable amount of effusion of blood in spinal canal

outside dura. Section of dura shows cauda equina without lesion or surrounding hemorrhage.

(14) Complete crushing of third, fourth, fifth, and sixth cervical vertebræ. Cord not removed owing to complete destruction and crushing.

2. *Cases in Which Doubt Exists as to Whether the Cord is Irremediably Damaged.* These cases should probably always have an open operation, but will be considered later.

3. *Cases in Which it is Fair to Assume that the Cord is Not Irremediably Damaged.* This class is of great interest and importance.

Dr. L. R. G. Crandon, of Boston, has collected a series of 17 cases of fracture of the spine without marked cord symptoms, which have come under his personal observation. He has pointed out to me that if they are unrecognized they may end most disastrously.

FRACTURE OF THE SPINE WITHOUT MARKED CORD SYMPTOMS.

1. Male, aged ten years. Buried by a cave-in of sand and gravel; brought immediately to hospital. Marked tenderness over lower dorsal and first lumbar spines, with swelling and kyphosis. Reflexes normal and no evidence of paralysis. Patient put on Bradford frame and fastened to it by swathe. Twenty-two days later plaster-of-Paris jacket applied. One month after injury patient up with jacket and two days later discharged, with marked knuckle in lower dorsal region and definite limitation of intervertebral flexibility, but no evidence of injury to the cord.

2. Male, aged six and one-half years. So far as can be learned an iron pipe fell on patient's side or back. Patient semiconscious; color good; pulse 130; slight bleeding from both nostrils; reflexes of eyes, trunk, and extremities normal. Crepitus and abnormal mobility of ninth and tenth dorsal spinous processes of second and third left ribs. Discharged in one month with no evidence of cord injury, but with slight scoliosis.

3. Male, aged thirty-nine years. Fell into hold of steamer. Pale, conscious, apparently in pain. Sternum fractured. Back

shows continuous curve from base of neck to first lumbar, with marked kyphosis at sixth dorsal. At this point is abnormal separation of spines and great tenderness. No crepitus made out. Abdomen: marked spasm of both upper quadrants. No paralyses and reflexes all normal. Bradford frame. Retention of urine made catheterization necessary for three days. In eight days the kyphosis still persisted, but sensation and motion of lower extremities were normal. In six weeks sat up with back carefully supported. Plaster jacket applied with spine hyperextended. In eight weeks sat up in chair and was without symptoms.

4. Female, aged twenty-six years. Fell one story, striking on back, across an iron fence. Unconscious for an hour. Marked knuckle at twelfth dorsal vertebra. Knee-jerk present on left, absent on right. No paralysis or lack of sensation made out. Bradford frame. Two and one-half weeks, plaster jacket. Radiograph negative. In six weeks was up and about with jacket; no symptoms. Discharged at her own request.

5. Male, aged twenty-two years. "Jack-knifed" while driving through a low doorway. Unable to walk; legs paretic, but sensation normal. Severe pain across back and marked abdominal spasm. Distinct kyphosis at twelfth dorsal, but this seems to consist of hæmatoma and of a loose spinous process, giving crepitus. Retention of urine called for catheterization for seventeen days. At the end of two months was discharged with "stiffness of back," but no other abnormality.

6. Male, aged twenty-four years. Fell from a tree about fifteen feet. Conscious; cyanotic; pulse 80; reflexes absent; Babinski on both sides. Both lower extremities delayed in sensation and paretic in motion for twelve hours. After that normal. Eighth dorsal spine unduly prominent; just below it a distinct gap; ninth process not felt. Patient got out of bed several times the first night without new symptoms. Bladder and rectum normal from the first. At the end of one month was discharged at his own request, with plaster jacket; no symptoms.

7. Male, aged twenty-three years. Fell three stories. Conscious; tender prominence over eleventh and twelfth dorsal vertebræ. No crepitus or disturbance of motion on sensation. Reflexes normal. Slight priapism. Bradford frame. In four weeks priapism con-

tinues, but no other cord symptom has been noted. In one month patient up (on his own insistence) and walks about, without back support, somewhat stiffly. Discharged.

8. Female, aged twenty-six years. On the tenth day of typhoid fever developed delusions and jumped from a second-story window to the ground, about thirty-five feet. The patient was unconscious; respirations were rapid and shallow; slight cyanosis. There was marked prominence of the ninth, tenth, eleventh, and twelfth dorsal and first lumbar vertebræ, with evident separation of spines of twelfth dorsal and first lumbar. No paralysis or anæsthesia. Abdomen distended. Kyphosis persists. Death at end of three days.

9. Male, aged thirty years. "Jack-knifed" under a bale of cotton. Conscious. Crepitation and abnormal mobility of eleventh dorsal spine. No paralysis or anæsthesia. Discharged well.

10. Male, aged forty-seven years. Fell one story down elevator well. Slight kyphosis at second lumbar vertebra. Reflexes, sensation, and motion normal. Sat up in twelve days with no sign of injury, except the persistent knuckle.

11. Male, aged thirty-two years. A mass of twenty-eight bricks fell on patient's bent back. Conscious. Marked separation of fourth and fifth dorsal spines, enough to admit tip of finger. Just above this fourth spine is unduly prominent. No paralysis or other sign of cord injury. Up and about in fourteen days without symptoms.

12. Male, aged thirty-eight years. Fell down stairs. Conscious. Soft swelling in dorsolumbar region. Twelfth dorsal spine unduly prominent. Sensation, reflexes, sphincters, and other muscles not affected in any other way. Discharged in seventeen days against advice.

13. Male, aged sixty years. Was thrown down a flight of stairs. Conscious. Dyspnœa. Abnormal mobility, crepitus, and pain over third and fourth dorsal spines. Discharged without symptoms in four days.

14. Male, aged sixty years. Fell off a bridge. Conscious. Reflexes normal. No loss of motion or sensation made out, but a marked kyphosis over eleventh and twelfth dorsal spine. Much abdominal spasm. No symptoms of cord injury developed dur-

ing two months. At the end of that time, although the deformity persisted, patient was up and about in plaster jacket.

15. Male, aged thirty-two years. Fell thirty-five feet from an electric-light pole. Conscious. Reflexes normal. General abdominal spasm. No loss of motion or sensation, but a definite kyphosis over first lumbar spine. Retention of urine first twenty-four hours. Discharged in two months with persistent kyphosis and wearing plaster jacket.

16. Male, aged twenty-six years. Intoxicated and in a fight fell from a second-story window to the ground. Conscious. Color good; breath alcoholic; pupils equal and react; tongue protrudes straight; pulse 100, regular, good quality; fine tremor of both hands. General abdominal tenderness and spasm; no motor paralysis. Slight prominence of spine of first lumbar vertebra. Considerable tenderness over this region; some pain on motion; no crepitus or abnormal mobility of spinous processes; able to move legs without difficulty; sensation normal. Plaster jacket applied with lordosis. Discharged after seven weeks. Able to walk slowly with great sensation of weakness in lumbar region and dependent upon plaster jacket.

17. Male, aged forty-one years. Tried to jump from one roof to another and fell four stories. Semiconscious. Apparently in great pain. Marked pallor. Pupils equal and react. Tongue not protruded on request. Pulse 120, regular, but of poor quality. Marked kyphosis, with apex of the knuckle at the junction of the tenth and eleventh dorsal vertebræ, where there is considerable separation of the spines. Marked abdominal tenderness and spasm. Knee-jerks absent. Cremasteric present. Patient grew worse through the day and in five hours was in a state of collapse. A pint of adrenalin solution, 1 : 50,000, was introduced into the vein of the arm and this was repeated twice at intervals of six hours. Pulse immediately responded and general condition improved. There was no motor paralysis at any time. The patient was kept on a Bradford frame for four months, and was then discharged wearing a plaster jacket. This man was brought into the hospital by the police in a chair, his head and the upper half of the trunk collapsed forward. A knuckle in his back presented, the whole picture being that of Pott's disease. Immediate rectification was done to

the extent only of placing the man on his back, and there he remained until complete union had taken place. At no time were there any cord symptoms.

This series of cases is, I think, worthy of careful consideration. Presumably in the past they have not gone to a hospital. The injury to the vertebræ in some of them is assumed from the symptom-complex, not from the existence of crepitus and abnormal mobility. It must be remembered that in certain adult spines there is present a kyphosis that is not dependent upon an obvious pathological lesion.

Symptoms of pressure on the cord may develop from the slipping of the fragments of a fracture of the spine where the cord was not primarily permanently injured. Dr. Crandon has seen one such case that deeply impressed him. It is as follows:

Male, aged fifty-five years. Fell down an elevator well and was brought immediately to the hospital. There was marked tenderness over the seventh cervical and the three upper dorsal vertebræ, together with slight spasm of the neck. No crepitus made out. Pulse 74; temperature normal; respirations 17. No paralysis or anæsthesia. Reflexes present and normal. Full control of sphincters.

Patient was put to bed and cautioned not to sit up or to roll in bed, because there was an injury to his back which might be more than was then apparent. Four days after injury, however, when unattended, *he sat up in bed and immediately complained of numbness of the limbs and body*. Examination then showed a paresis of all the skeletal muscles from the neck down and diminished cutaneous sensation from the clavicle downward. Reflexes increased. Abdomen somewhat distended. Bladder paretic and sphincter ani relaxed.

Two days later the plantar reflexes and the knee-jerks were absent; absolute paralysis of lower extremities. Right arm: very slight power of flexion and slight power of supination; extension of elbow lost; pronation of wrist lost; very slight power of deltoid; pectorals and latissimus dorsi lost. Sensation blunted to pinprick over ulnar half; sharp over ball of thumb; blunted over both sides forefinger; lost over middle finger; sharp over deltoid; sharp

over radial aspect of forearm. Left arm: flexion good; extension of forearm lost; deltoid, pectorals, and latissimus fair; pinprick of limb diminished; radial aspect diminished; over deltoid normal; ulnar side diminished. Sensation absent from toes to level of fourth rib, and blunted from fourth to second rib. Pupils equal and not dilated. Diagnosis: complete injury at seventh segment; sixth segment blunted.

Operation advised at the first onset of these symptoms. Not accepted, and patient died at the end of a month, with the usual picture of fractured spine and complete destruction of the cord. Autopsy showed fracture of the first dorsal and complete degeneration of the cord at that level, but without macroscopic change in the envelope of the cord.

In the care of this class of bony injury of the spine, surgery can protectively be of great value. To the police, to hospital attendants, to house officers, and to medical students, the instruction for the care of injuries to the back should be "*hands off!*" Let the patient be transported to the surgeon, so far as is possible held fixed in the position in which he is found.

*Can We Tell Whether a Spinal Cord is Irremediably Damaged or Not?* In some cases it is obvious from the character of the injury that the cord is severed or crushed. A total transverse destruction of the cord may be deduced from the *persistence* of the following symptoms: The total loss of all reflexes, complete insensibility to touch and pain, and motor paralysis below the level of the lesion.

Thomas,[1] whose work on the changes in the spinal cord following fracture of the spine is of great value, stated that the "factors in drawing the conclusion that there is a complete transverse lesion of the cord are:

"1. Complete paralysis, usually of a flaccid type.

"2. A complete loss of sensation in all its forms.

"3. Absent reflexes, especially the knee-jerk, while the plantar reflex, on the contrary, is often retained.

"4. Complete paralysis of the bladder and rectum, with priapism.

[1] Boston City Hospital Medical and Surgical Reports, 1900.

"5. Vasomotor paralysis, with severe sweating in the paralyzed parts.

"6. And, most important, absence of variations in the symptoms.

"7. Absence of irritative phenomena, such as pain."

Walton,[1] who has studied fractures of the spine, states: "There are no symptoms which establish (otherwise than through their persistence) irremediable crush of the cord. . . . While total relaxed paralysis, anæsthesia of abrupt demarcation, total loss of reflexes, retention, priapism, and tympanites, if persistent, point to complete and incurable transverse lesion, the onset of such symptoms does not preclude a certain degree at least of restoration of function." He also states that we have no infallible guide to the extent of the lesion.

TREATMENT. The treatment of fractures of the spine comes under the following headings: 1. Expectant. 2. Reduction and fixation. 3. Operation (laminectomy), which may be (*a*) primary; (*b*) secondary. The selection of the kind of treatment should depend on what injury to the cord exists or what injury to the cord is likely to occur.

1. *Expectant Treatment.* This mode of treatment is applicable to fractures of the spinous processes or even of the other bony structures where there are no cord symptoms. The expectant treatment consists in having the patient fixed in bed, preferably on a Bradford frame, to facilitate his care. The nursing care is most important. The expectant method is one which manifestly holds out little hope of complete recovery in cases of definite cord injury.

2. *Reduction and Fixation.* The immediate, bloodless, rectification of a fracture of the spine and its fixation by a plaster-of-Paris jacket was the mode of treatment which I advised in selected cases in my first series. If a detailed local examination is to be made, the patient should be turned only as a whole. Rectification should be attempted very slowly, and so far as is possible in the axis of the spinal column. During every step of this operation it is desirable that the condition of the cord, as shown by sensation, motion, and reflexes, should be known. Should the slightest sign

[1] Journal of Nervous and Mental Disease, January, 1902.

or symptom of cord injury or pressure develop, the rectification should stop and an immediate open operation be done. If the kyphosis is very marked or if upon extension it does not readily reduce, an immediate operation, unless there is some contra-indication, such as shock, should be done, so that the reduction may take place while the cord is under the surgeon's eye. The deformity may be corrected and the jacket applied with the body suspended or by the horizontal hammock suspension position. In short, the jacket should be applied after reduction has been attempted by firm, even pressure at the site of the deformity, with enough hyperextension to open the narrowed spinal canal to its normal limits.

In 1887 I collected 16 cases of immediate rectification of the spine and fixation with a plaster-of-Paris jacket. Of these, 3 died, 3 derived no benefit, and 10 were greatly improved.

The conclusions reached by the writer in 1887 were as follows:

"First. That in the *immediate* correction of the deformity and fixation with plaster-of-Paris jacket or other means, we have a rational method of treating a large number of cases of fracture of the spine. Second. That, considering the hopelessness of results in fracture of the spine when treated expectantly, almost any risk is justifiable. Third. That the *immediate* correction of the deformity is imperative, *if* softening of the cord can and does occur from pressure at the end of forty-eight hours. Fourth. That the suspension of the patient is only a means of rectifying the deformity; that certain fractures could be simply pressed into position while the patient lies prone or supine.

"The objections to the treatment are:

"First. That the expectant plan of treatment gives a small percentage of recoveries. Second. That there are serious risks, especially in the cervical region, attending the suspension of a patient and the rectification of the deformity with a fractured spine, in the way of shock, collapse, and death. Third. That in attempting to relieve pressure on the cord, by rectifying the deformity, we might either sever the spinal cord or make pressure upon it. This is a matter of chance.

"My own belief regarding the status which the procedure should occupy in surgery is that it will occasionally be a life-

saving measure; that it should be applied under anæsthesia in all cases of fracture of the spine, which are not conclusively known to be irremediable; and that, apart from the chance of recovery offered to the patient by this means, it will almost invariably make the patient more comfortable, in that he can be handled more easily."

In 1894 in the second series (86 cases) the percentage of recovery was 33 per cent. The treatment had been influenced by the first paper in 1887. In the first series of cases 18 patients recovered; 9 recovered "useful"—that is, could walk; and 9 recovered "useless"—that is, were bedridden. In the second series of cases (86) 28 recovered, 19 were "useful," and 9 were "useless." Not all of the cases were treated by the immediate rectification of the deformity; in fact, it was applied during the year 1887 four times, during the year 1888 twice, during the year 1889 three times, during the years 1890 and 1891 twice, and only once in 1893.

More experience, as is usually the case, has brought more light, and I now believe that the indication for immediate reduction and fixation is for cases of fracture with no cord symptoms, and for cases not hopeless which refuse an open operation.

3. *Laminectomy.* The technique of the operation that I use is practically that described by Munro.[1] A single incision is made in the median line and is carried down to the lamina on either side close to the spinous process. The wound is packed and the lamina on the other side is exposed in like manner. The interspinous ligaments above and below the selected spine are cut with blunt scissors curved on the flat. The spinous process itself is bitten off with a rongeur, the laminæ are next cut near the middle line with small bone forceps, and the intervening piece removed, thus exposing the cord without even putting it in danger of injury. Successive laminæ should be removed until it is positive, without any chance of error, that all compression of the cord, above and below, or of spinal nerves still in the canal, is removed. The dura should be opened freely; spicules of bone should be removed; the dura should not be sutured, and drainage by a bit of rubber tissue may or may not be necessary.

In the open operation lies our hope—a hope, unfortunately, and

[1] Journal of the American Medical Association, January 6, 1900.

nothing more. The advocates of operative surgery of spinal cord injury are divided into those who favor immediate operation and those who advise a delayed operation. Relatively few surgeons are in favor of an operation within a few hours. The arguments against immediate operation are that an injury which has involved destruction of the cord is already done and will get no worse in a few hours. The patient is still suffering from spinal shock and general shock.

I believe in immediate operation unless it is distinctly contra-indicated by shock. The reason that I believe in immediate operation is that no one can positively state in what condition the spinal cord is until he looks and sees, and if pressure exists on the spinal cord and it is allowed to persist for many hours irreparable damage to the cord may result. I recognize that it would be advisable to exclude spinal concussion, which at times might simulate pressure on the cord; but while waiting for the spinal concussion to clear up, if pressure on the cord exists, irreparable damage may result. I agree largely with Walton and Lloyd in fearing delayed operation in cases which have recovered from their first shock and have in them anything objectively hopeful.

Oliver[1] states that "a point which has been regarded as very important in these cases is the length of time that elapses between the receipt of the injury and the performance of the operation. The usual advice has been to operate as soon after the infliction of the injury as is possible, because of the fear that prolonged pressure may of itself produce degenerative changes in the cord from which the patient never recovers." Dr. Oliver states that "analysis of the statistics seems to throw some doubt upon the correctness of this dictum." He instances cases by Lauenstein, McCosh, Huss, Starr, Wyeth, and one of his own cases, where recovery had occurred from late operation on a fracture of the spine. Dr. Oliver says: "If the injury is not irreparable at the time of accident, it is unusual for any bony or other pressure to cause a permanent abolition of function."

I recognize that the successful laminectomies for fracture of the spine have almost invariably been late operations. Notably this

[1] Injuries of the Spine and their Treatment, Cincinnati Lancet-Clinic, November 7, 1903, p. 480.

is the fact in Horsley's cases. If, however, the late operations are successful at times it perhaps may be assumed that these same cases would have been successful if an operation had been done early; at least they would not have been subjected to the risk of uncertainty as to whether pressure on the cord was producing irremediable damage. I cannot believe that pressure on the cord should be allowed to persist any longer than is imperative from the general condition of the patient.

Thorburn[1] is pessimistic. Speaking of 7 cases of operation, he says: "In none of the cases did any real benefit result; all those in which the injury was in the cervical region died; all those in which it was below the cervical lived, but did not recover from paralysis. . . . The published cases, of which there are about 200, show to my mind no better results, if we exclude injuries of the laminæ, hemorrhage, and operations upon the cauda equina. I have, indeed, not satisfied myself that there have been any successes, as regards recovery of function, save such as may be attributed to the regeneration of nerve roots only, or to the natural recovery of a cord which was but very slightly injured. . . . And, further, if it were shown that in one or two instances among the 200 published cases there had been a definite improvement or recovery, I should be inclined to regard such as the sequel of some error in the original diagnosis, rather than to allow a single instance to invalidate a rule based upon such extensive premises."

Lloyd[2] is more hopeful, and, it seems to me, just in his estimate of the surgical results in these cases. He says: "It is, therefore, evident that if we operate immediately after the injury we will have failures that should not be charged against the operation itself, and, if possible, we should wait before operating until the question can be settled whether the patient will overcome the shock or succumb directly to the effects of the injury.

"There is another objection to immediate operation. In so-called concussion of the spine there may be a certain amount of anæsthesia and paralysis. The recovery, however, will be complete, or at least so nearly that no appreciable lesion can be

[1] British Medical Journal, June 23, 1894, p. 1348.
[2] Philadelphia Medical Journal, February 15, 1902, p. 335.

made out. Immediate operations in these cases would be unnecessary, as they would have recovered spontaneously had they been left alone for a sufficient length of time. It is impossible, too, in the first few hours, to determine with any degree of certainty how severe the injury really is, nor can we absolutely localize the injury to the cord. In my opinion, therefore, we should wait until this period of shock has passed, and until it is evident that there will be no spontaneous recovery complete enough to render life bearable. If after this period has passed the patient still continues to improve no operative interference should be considered, but as soon as the symptoms begin to show retrograde phenomena or seem to have reached the end of the improvement, operation should be undertaken."

Lloyd[1] published the following table of laminectomies in 1902:

| Cervical Region. | Immediate operation. | Later operation. |
|---|---|---|
| Deaths | 21 | 2 |
| Recovery | 0 | 2 |
| Improved | 2 | 1 |
| Not improved | 0 | 4 |
| Subsequent death | 4 | 3 |
| | 27 | 12 |

| Dorsal Region. | Immediate operation. | Later operation. |
|---|---|---|
| Deaths | 23 | 5 |
| Recovery | 4 | 10 |
| Improved | 9 | 18 |
| Not improved | 6 | 16 |
| Subsequent death | 7 | 16 |
| | 49 | 65 |

| Lumbar Region. | Immediate operation. | Later operation. |
|---|---|---|
| Deaths | 4 | 4 |
| Recovery | 1 | 6 |
| Improvement | 1 | 6 |
| No improvement | 0 | 4 |
| Subsequent death | 0 | 2 |
| | 6 | 22 |

[1] Surgery of the Spine. Philadelphia Medical Journal, February 22, 1902, p. 374.

Sacral Region.

| | Immediate operation. | Later operation. |
|---|---|---|
| Deaths | 0 | 0 |
| Recovery | 0 | 1 |
| Improved | 0 | 3 |
| Not improved | 0 | 0 |
| Subsequent death | 0 | 0 |
| | 0 | 4 |

He states that "these statistics are decidedly against immediate operation, and we must urgently advise never operating until it is evident that the patient will not succumb to the direct effects of the injury. As soon, however, as he has recovered from the shock and his exact physical condition is known the operation should be performed."

Victor Horsley's cases, reported to the British Medical Association in 1895,[1] are the most brilliant. Of the seven cases reported three were fractures of the spine. They are as follows:

"1. There was a fracture of the cervical spine, with paralysis of all four limbs, which had lasted eight months. The paralysis began to extend. Analgesia was present, and this always points to an affection of the central gray matter of the cord. The laminæ of the fifth and sixth cervical vertebræ were removed, and the thick fibrous tissue was dissected off the dura mater. The patient steadily improved, and only wasting of the interossei remained."

"2. The patient had fallen from a cart, striking his head and right shoulder. He walked about for a week, but gradually lost power in all his limbs. When admitted to Queen's Square Hospital, fracture of the sixth cervical vertebra was diagnosed. The left optic disk was swollen. Laminectomy of the fourth, fifth, and sixth cervical vertebræ removed a ridge which had been pressing on the spinal cord. Power began to appear on the twelfth day. He has since recovered completely."

"3. The patient sustained a fracture of the sixth cervical vertebra; the onset of paralysis was gradual. There was marked contracture and well-marked anæsthesia of the postaxial border of the upper limbs. The arches of the sixth and seventh cervical

[1] Lancet, August 17, 1895, p. 437.

vertebræ were removed, when a projecting ridge was felt, but on extension this disappeared. He is recovering slowly."

The last case may have been a fracture of the spine, and is reported as follows: "The patient had struck the forepart of his head, and, after walking two hundred yards rapidly, became completely paralyzed. After partial recovery spastic paraplegia appeared, with postaxial anæsthesia of the upper limbs. The laminæ of the sixth and seventh cervical vertebræ were removed. Permanent recovery commenced three weeks after the operation. He can now walk a mile."

The following is a list of some of the laminectomies that have been collected from the literature of the subject since Lloyd published his table: It must be recognized that it is not common for surgeons to publish their unsuccessful cases.

Van Engelen[1] reports three operative cases:

1. Paraplegia as the result of a fresh fracture. The cord was found crushed to a pulp; death in fourteen days.

2. Fracture of skull and spine, apparently dying. After trephining, both skull and spine consciousness returned, motor and sensory power in the lower extremities reappeared, but patient died three weeks later from tetanus.

3. A young woman, after fracture of the spine, suffered paraplegia and pains of the legs. Since sensation was retained, operation was done. Paraplegia was not relieved.

Hahn[2] reports four cases:

1. Man, aged fifty-one years; fell three stories; much shock; paralysis of both legs. Sensation doubtful, because drunk. Next day pulse better; paralysis persisted; reflexes gone; incontinence; complete loss of sensation from Poupart's down. Operation three weeks later. Fracture third lumbar up to twelfth dorsal. A fragment of twelfth dorsal narrowed the canal, pressing along 1 cm. of the cord. The dura was opened and the wound drained. Pain was relieved and sensibility improved for a time.

2. Man, aged thirty-eight years; fell twenty-five feet; conscious, with pain, paralysis of right leg and bladder, some power in left leg, which disappeared in twenty-four hours. Reflexes lost; sensi-

[1] Journal Medical de Bruxelles, No. 31, 1902.

[2] Ueber Ruckenmarks Chirurgie. Deut. Ztschr. f. Chir., 1902, lxiii. p. 426.

bility of legs much diminished. Retention of urine; incontinence of feces. Operation in six days. Fracture of the first lumbar; change in canal noted anteriorly. The cord compressed slightly but not torn; wound drained. Some sensation returned, but patient died in one week.

3. Man, aged forty years; fell three stories; paralysis of both legs; sensation lost from pubis down. Operation nine weeks later. First and second laminæ removed. A bit of bone was driven under the cord and compressed it from behind forward; fragments were removed. In one week bladder and rectum improved. The wound healed. Four months later the patient discharged, with mobility and sensation not improved.

4. Man, aged twenty-two years; fell twenty feet into water, and his horse fell after him; swam ashore with arms only; had pain in the back and was numb in the legs. Sensation of legs gone; mobility from hips down lost. Operation three days later. Fracture of last dorsal and first lumbar; compression of cord by fragments; dura not open; the cord seemed normal. Died without improvement.

Winnett[1] collected six cases, which may be called successful, and to these added one of his own, on which Peters operated. The cases are as follows:

1. Surgeon, McCosh. Man, aged thirty-three years. Eighteen months previously sustained a fracture or dislocation of the fourth, fifth, or sixth cervical. For nine months bedridden. Caused by shackle falling on his head and doubling him up. Completely paralyzed below the clavicles. At time of operation atrophy of muscles, but stands with assistance. Spastic paralysis of left arm. Some use of right arm, but not of hand. Constant pain in upper limbs. Operation: fourth displaced one and a quarter inches to left. Removed arch of fifth; dura very vascular and attached to arch; not opened. Result: gets about, uses arms, walks four miles, and writes with left hand.

2. Surgeon, John A. Wyeth. H. A., aged twenty-one years. September 1, 1889, thrown from a cow-catcher to track. Loss of motion from pelvis down; bladder and rectum paralyzed. Opera-

[1] Canadian Practitioner, January, 1905, vol. xx. p. 1.

tion April 30, 1890: Removed laminæ, last two dorsal, and upper two lumbar. Bodies found crushed and cord partly divided. Undivided part compressed by laminæ of vertebra above and body below. Compressing bone was removed and dura closed. Result: immediate slight improvement in motion, especially in feet; 1894 good use of legs and feet, but uses cane.

3. Surgeon, Ridenaur. M. N., aged twenty-eight years. December 11th crushed by an overhead beam in such a manner as to crush centre of his back forward at an acute angle, frightfully lacerating and crushing parts. Seventh dorsal depressed one inch and eighth absent. Lamina of seventh dorsal broken and separated. Transverse processes of seventh torn off. Intervertebral disks of seventh forward one inch. Spinous process of eighth penetrating cord. Body of eighth fractured. Membranes punctured and lacerated, and hemorrhage into arachnoid space. Operation: Removed roof from sixth and ninth dorsal. Sensation returned at once. Motion in recti at end of fourth day. Catheter required until seventh day. Sphincter ani restored at end of first week. Knee-jerk restored at end of second week. Lift limb from bed at end of fifth week. Walk with crutches at end of three months.

4. Reported in *American Journal of the Medical Sciences*, April, 1892. Fracture dislocation between tenth and eleventh dorsal. Opened five hours after and large extrathecal clot washed away; vertebræ reduced and spines held together by silk. Paralysis and hyperæsthesia passed away.

5. Surgeon, Boyle. S. M., aged twenty years. Struck in back by train May 8th. Loss of motion and sensation below hips. Reduction failed. For first week catheterization. Pain and hyperæsthesia in both legs. Operation July 12th: Dislocation backward between ninth and tenth, above and forward of last dorsal, and first lumbar below. All arches removed and bodies grooved. Second day after operation slight movement in toes, also sensation. At present has good sensation and motion.

6. Surgeons, Church and Eisendrath. Fracture dislocation of tenth dorsal, with complete paraplegia. Extradural hemorrhage found, clot removed, and vertebræ reduced. Result: cured.

7. Surgeons, Peters and Winnett. Male, aged twenty-nine years. He dived into four feet of water, his head doubling under him.

Physical examination: mind clear; sensation normal down to nipples. Tactile sensation present, but indistinct over the remainder of the surface, with the exception of the forearms and hands. Contact of clothes was hot and painful; no other pain since; retention of urine; paralysis of rectum; contraction of pupils. Irregularity of fourth and fifth cervical spines. All muscles below the neck, except the diaphragm, paralyzed. A small spicule of bone was found in the membranes over the fourth left lamina. The spine of the fourth was bent to the left. The membranes were opened, blood and spinal fluid escaped, and pulsation returned. The case was discharged the nineteenth week, with bladder normal and patient able to move left hand.

The writer presents the following conclusions:

1. That fractures of the spine may well be divided into two classes: first, fractures of the spine with injury to the cord; and second, fractures of the spine without injury to the cord.

2. That it is not best to decide what the treatment of an individual case of fracture of the spine should be from the statistics, because the lesion varies so widely.

3. That in many cases of fracture of the spine it is impossible to primarily state whether the cord is crushed or pressed upon by bone, blood, or exudate, except by an open operation.

4. That only by the *persistence* of total loss of reflexes, complete insensibility to touch and pain, and motor paralysis below the level of the lesion can total transverse destruction of the cord be diagnosticated.

5. That if pressure on the cord is allowed to remain for many hours, irreparable damage to the cord may take place.

6. That unless it is perfectly clear that the cord is irremediably damaged, an open operation to establish the condition of the cord and to relieve pressure is imperative as soon as surgical shock has been recovered from.

7. That in certain cases of fracture of the spine, when the cord is not injured, but is liable to injury from displacement of the fragments of a vertebra, rectification of the deformity and fixation of the spine may be used.

8. That if the cord is crushed, no matter what treatment is adopted, there will, of necessity, be a high rate of mortality.

# A CASE OF SUTURE OF THE SPINAL CORD FOLLOWING A GUNSHOT INJURY INVOLVING COMPLETE SEVERANCE OF THE STRUCTURE.

By GEORGE RYERSON FOWLER, M.D.,
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A. E., aged eighteen years, clerk, born in the United States, single. This patient was admitted to the Brooklyn Hospital on April 28, 1903, with the following history: He suffered from pneumonia several years ago. Four years ago, while working at a machine, his left hand was caught in the latter and so badly crushed that it became necessary to amputate four fingers. He had gonorrhœa six months ago; no discharge at the present time.

Shortly before admission he was shot in the back, his assailant using a 38-calibre revolver at a distance of about thirty feet; the shooting took place somewhat from the right side. He suffered severely from shock, and paralysis of the lower extremities occurred at once.

*Examination on Admission.* The bullet wound was situated one and a quarter inches to the right of the median line and on a level between the tenth and eleventh dorsal spines. He was found to be paralyzed below the waist; sensation was absent over all of both lower extremities and over the abdomen as high as one inch above the crest of the ilia on the sides, and about half-way between the symphysis and the umbilicus in front. The bladder and rectum were also paralyzed. The bowels moved involuntarily and irregularly and without the volition or cognizance of the patient; there is considerable twitching of the muscles of both legs, especially the toes.

*Operation May* 9, 1903. Ether anæsthesia. An incision was made six inches long over the spines of the vertebræ, the middle of the incision resting upon the eleventh dorsal spine. The laminæ

of the tenth, eleventh, and twelfth vertebræ were removed by the chisel. The bullet was found lying transversely between the severed ends of the cord, concealed from view by a large blood clot. A very narrow, ragged, and contused strip of dura, scarcely more than one-eighth of an inch in width, remained intact. The blood clot was carefully sponged away and the bullet removed. The ends of the cord were then sutured with three fine chromicized catgut sutures, the dura being included in the sutures. No special difficulty was experienced in drawing together the ends of the cord and closing the defect, the latter representing in width the diameter of the 38-calibre bullet. The dura was further secured with a number of sutures of fine catgut, and a drain consisting of a half-dozen narrow strips of oil-silk protective introduced. The skin incision was sutured with silkworm gut.

On May 30th the following note appears on the hospital record: "Wound healed, upper line of anæsthetic area from one and a half to three inches lower than before operation. Twitching of toes of both feet and occasional clonic muscular spasms of the flexors and extensors of the thighs; the patient says his "feet jump up on him." Can feel when the bowels move, but is without control of the rectum. Can feel distention of the bladder with urine, but is without control."

*Examination by Dr. William Browning on June 7th.* "It is found that no sensation can be definitely determined in the lower extremities which responds to any test, except where some muscular contraction occurs following motions producing pain, as spasm by jarring. There are frequent slight movements in the toes, these being noticeably present in the big toes. There is no cremaster jerk; the knee-jerk cannot be developed. Ankle clonus is absent; Achilles-jerk present on both sides. It is not certain that he can move either toe at will; occasionally he would appear to do so, but more often the motion would be in the other foot; in fact, there is so much spontaneous motion as to make what otherwise might appear to be a movement in response to the will purely accidental. Babinski's reflex in extension symptom (the upward jerk of the toes) is present on each side; there is also some upward motion of the toes on plucking out hairs on the front of each leg."

During July bed-sores developed on the buttocks and heels.

These became quite deep, the sacral sore extending into the muscles. During November cystitis developed, and irrigation of the bladder was done daily for about eight weeks, and urotropin, gr. iv, every four hours, administered. Under this treatment the cystitis improved. Patient was encouraged to sit up and go about in a wheel-chair, when the bed-sores healed rapidly. In January, 1904, a lobar pneumonia developed, from which the patient recovered without any untoward event. During the spring and summer of 1904 the sensation of the presence of the contents of the bladder and rectum was greatly improved. Occasional recurrences of cystitis were kept under control by irrigation and urotropin. Following the healing of his bed-sores he was treated by massage and electricity, and, assisted by an attendant, has taken daily walking exercise in a cage-like support resting on wheels, arranged somewhat like the "baby tender" of the nursery. With the aid afforded by this support and braces to stiffen the knees he managed to move about from place to place in the hospital.

During the winter of 1904 and 1905 his bladder and rectum sensations improved. He was able to tell when a movement of the bowels was imminent, and at times is able to retain it for a while. The same is true of the bladder. Erections were easily excited and persistent, but not painful. Both legs were spastic and quite useless for locomotion, except with the help of the apparatus above mentioned.

The following is a report of his condition in January, 1904, by Dr. F. C. Eastman, assistant in neurology at the hospital:

"*Sensation.* This is abolished in the legs and trunk as high as a line extending across the front of the body at a point one and a half inches above the pubes, and in the back represented by a curved line about half an inch below the level of the iliac crests. Above this there is a zone of marked hyperæsthesia, about two inches in width, though there is some irritability of the whole cord above the level of anæsthesia. There is an area about five inches in length extending down the outer side of the right thigh, where there seems to be some sensation, but the patient is not able to correctly distinguish between heat and cold, nor is he able to correctly localize tactile sensations, which are usually referred to a point two or three inches distant.

"*Voluntary motion* is completely lost in the affected area. There is loss of bladder and rectal control, the former at least acting automatically; the patient is able to tell just before the act that he is about to urinate.

"*The abdominal and cremasteric reflexes* are lost. Virile and epigastric reflexes are present. The kneo-jerks are exaggerated, particularly the left. The Achilles reflex is marked, particularly on the right side. Right Babinski reflex more marked than the left. Permanent right ankle clonus is absent on the left side. Marked rigidity and spasticity of both legs are present. Tendency to priapism. Left leg and thigh one-quarter of an inch larger than the right.

"*Trophic Changes.* Slight atrophy of both legs, probably from disuse. Marked atrophy of glutei muscles on both sides. The muscles involved are apparently situated too far down for this atrophy to be the result of destruction of the cells of the anterior horn at the point of lesion, so that it may be simply from disuse, as these muscles atrophy more readily than any others in the body.

"The skin is somewhat dry and scaly, but there is very little trophic disturbance at the present time."

Examination made by Dr. Eastman on June 12, 1905, shows the data to be practically identical upon comparison with the former report, with the following exceptions: In the former examination it was stated that the anæsthesia extended upward in front to a point one and a half inches above the pubes. It is now found that the anæsthesia extends only to the pubes; the area of anæsthesia on the right leg and on the back, however, corresponds perfectly with the former findings. There is no reaction or degeneration of any of the leg, thigh, or gluteal muscles.

Remarks. The main points of interest in this case relate to the possibility of regeneration of the spinal cord following a destructive lesion. Prior to the report of the Stewart-Harte case, in which the cord was sutured after it was severed by a bullet, it was the opinion of the majority of investigators that such regeneration in man did not take place. Mikulicz, of Breslau, endeavored to demonstrate the possibility of a successful regenerative process in the lower animals following section of the cord, but without result. Spiller and Frazier found that after division of a posterior root in

the dog, followed by immediate suture, regeneration occurs, but that regeneration of the cord itself does not occur.

In comparing the result in the case reported by Dr. Stewart with the conditions present in the case herewith reported, the following points are worthy of note: Sixteen months after the injury, in the Stewart-Harte case, the patient was able to flex the toes, flex and extend the legs and thighs, and rotate the lower extremities. While in the sitting position she could raise the extended leg from the floor; she was able to stand by supporting herself with her hands on the back of a chair. The bowels were under control, except when diarrhœa was present, and moved every second day. The urine passed voluntarily amounted to about sixteen ounces in twenty-four hours; incontinence occurred during sleep. She had the sensations of touch, temperature, pain, and locality; the difference between heat and cold, however, was not always distinguished. Rigidity of the muscles was present in a moderate degree; both ankle clonus and patellar clonus were present on each side. Reactions of degeneration were absent. No bed-sores had ever developed, and the skin and nails showed no trophic changes.

In the case herewith reported the following is to be noted in comparison: Twenty-six months after the injury voluntary motion is practically lost in the affected area. The patient is able to stand when supporting himself by the hands resting upon an apparatus, and to make some locomotion by swinging movements in a special frame on wheels. The bladder and rectal control is doubtful, to say the least, the former acting automatically. He has the sensation that the bladder and rectum are about to empty themselves, and if the urinal or bedpan are brought to him promptly soiling is prevented. The amount of urine passed in this manner would probably average more than a pint in the twenty-four hours. Urine is sometimes voided during sleep. Sensation is practically abolished in the entire affected region, with the exception of an area about five inches in length extending down the outer side of the right thigh, where some sensation is present. He is not able to correctly distinguish between heat and cold. Tactile sensations are recognized, but are usually referred to a point two or three inches distant from the point touched. Marked rigidity and spasticity of both legs are present. Patellar reflex exaggerated; Achilles

reflex marked. Ankle clonus present on one side and absent on the other. The reaction of degeneration is absent. Upon this point Dr. Eastman reports as follows:

"I examined E.'s muscles as you desired and can report that there is no reaction of degeneration of any of the leg, thigh, or gluteal muscles; further than that I cannot say positively. I could not get the reaction in any of the muscles that I tried. The trouble is that the back and abdominal muscles, which are supplied with nerves from the point of the lesion, are innervated from so many segments that lesion of any one segment does not destroy their activity, and then I could not react at all some of the muscles in the deeper layers of the back." Bed-sores developed in the third month; these extended to the muscles and were six months in healing. The skin shows but slight, if any, evidences of trophic disturbance.

An important comment is suggested in comparing these cases, namely: The Stewart-Harte case was operated on three hours after the injury, while in the present case upward of ten days had elapsed before consent to interfere operatively was obtained. The prolonged separation of the divided ends of the cord and the presence of the foreign body may have had an influence in preventing a more complete regeneration of the cord, as apparently occurred in the first case, provided, of course, that even relatively complete regeneration does actually occur. While the case in hand is therefore not as striking in many of its features as the Stewart-Harte case, it presents some points of interest, and for this reason is offered as a contribution to the literature of the subject.

Finally, the influence exercised by the possible presence of undiscovered uninjured portions of the cord, or of nervous structures in portions of the dura remaining intact in these and similar cases may be taken into account. It is undoubtedly true, if such a possibility can be conceded, that this takes place also in connection with injury of the cord occurring as the result of fracture of the vertebræ, and the varying end results of operative interference in such cases may be accounted for, to some extent, by the varying extent to which a final nerve anastomosis may take place through the medium of uninjured portions of the dura in different cases.

This likewise suggests the occurrence of a relatively efficient nerve anastomosis through the medium of branches of adjacent nerve trunks having their origin respectively above and below the lesion, and this in turn to the possibility of still further enhancing this effect as a final result by operative anastomosis of the nerve trunks themselves. This assumes, of course, a relative limitation of the ascending degenerative processes in the elements of the cord itself, as well as of the axis-cylinders of the divided and sutured nerve trunks, and resulting innervation of the parts below the lesion and of those supplied by the injured segment of the cord, conditions not incompatible with those that may have obtained in the Stewart-Harte case, and to a lesser extent, perhaps, in my own case.

# SPINE: TUBERCULOUS CONDITIONS REQUIRING SURGICAL AND MECHANICAL RELIEF.

By De FOREST WILLARD, M.D.,
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Traumatisms of the spine and neoplasms of the spine have been so ably discussed at this symposium by other more competent surgeons that there remains for me to speak only of the tuberculous and inflammatory conditions which are the result of slower processes. The most common pathological process encountered is that mixed infection, tuberculous and inflammatory, which is the result of spinal caries.

The most prominent surgical measures employed for the relief of this condition are:

1. Laminectomy for paraplegia.
2. Forcible immediate straightening of the kyphosis.
3. Forcible gradual straightening of the kyphosis.
4. Erasion of carious bone.
5. Wiring of the spinous processes.
6. Evacuation of pus accumulations.

1. *Laminectomy.* In the majority of cases, especially in children, the carious process may be arrested and a cure effected by rest, hyperextension, and fixation of the diseased area for a long period of time; yet in a certain number of instances a deposit of tuberculous material within the spinal canal enveloping and pressing upon the spinal cord produces partial or complete paralysis of motion and sensation. Following this tuberculous deposit an ascending or descending pachymeningitis may result with permanent thickening of the membranes sufficient to interfere permanently with nerve transmission. Pus formation may still further interfere with function. Added to the pressure already alluded

to may be bony pressure from caries of the vertebral bodies, thus angulating the canal and in some instances narrowing the calibre by actual bony encroachment. In 98 per cent. of the cases, however, the diminution of calibre and the interference to nerve transmission are due to the first-named cause, while in only 2 per cent. is compression due to bony pressure. This fact is readily appreciated when it is noted that some of the worst cases of spinal caries paraplegia are those in which the kyphosis is moderate or even small, and again, that paralysis is absent in cases of most marked posterior angularity. The region of the spine most prone to yield the paraplegic complication of spinal caries is the upper dorsal, where the bony canal is limited in size and where even a small amount of intraspinal deposit yields most serious consequences. The clinical experience of every surgeon in this room, however, has taught him that even a severe grade of paraplegia may recover, although great angularity still exists, provided the tuberculous and inflammatory deposits are absorbed. The amount of paralysis and the consequent symptoms will depend upon the position, extent, and character of the tuberculous deposit. You are all familiar with the symptoms: A child affected with spinal caries begins suddenly or slowly to show evidences of feeble locomotion, loss of sensation, increased knee-jerk and ankle clonus, rigidity of limbs, gradual contraction of some group of muscles, frequently loss of control of sphincters of bladder and rectum, sometimes priapism persistent and painful. Fifteen or twenty years ago the exceptionally good results secured in a few cases by Macewen, Horsley, Lauenstein, and others encouraged us to hope that in laminectomy we had found a speedy method of relief. Unfortunately larger and fuller personal experience has demonstrated that while a few cases are permanently benefited by operation, yet that the mortality is high, and even when temporary improvement takes place, relapses were common and permanent benefit uncertain.

The operation, therefore, while it has not been abandoned, has, like trephining of the cranium for epilepsy, been limited in its application and made secondary to other measures. Those measures have for their object the arrest and lessening and limitation of the bony destructive process and the permanent bridging and

repair of the destroyed vertebral bodies. Added to these should be the employment of all the hygienic measures available. Among the latter it is unnecessary to say that sunlight and fresh air hold the first places. In my experience the prognosis in spinal caries paraplegia under so-called conservative methods has been so successful that I hesitate, save in very exceptional cases, to recommend operative procedures until other measures have failed. Thorough and complete rest, fixation of the diseased area, and progressive forcible straightening have yielded such good results that I have now many cases walking the streets which for a period of more than a year seemed incurable. I am inclined to prolong the treatment even to two years, when signs of improvement are evidenced. Of course to be effectual the rest should be absolute, the diseased vertebræ being so fixed that motion of the carious bones is reduced to a minimum. This can be accomplished by head extension in bed, by hyperextension upon a Bradford or Goldthwait frame, by plaster-of-Paris or other fixed dressing to the spine. Internally the iodide of potassium and iodide of iron are helpful, but rest and fixation are the prime elements in the cure. Should the paralysis continue beyond eighteen months or two years the removal of the laminæ may, however, assist in the relief of the paraplegia, especially when the cord can be cleared from tuberculous deposits. The mortality is unfortunately so high that after many years of test I find myself resorting less frequently than formerly to laminectomy for caries paraplegia, while in traumatisms of the spine I am more and more convinced of the benefit of early interference. When the vertebral bodies are carious a laminectomy removes the only remaining healthy portion of the vertebræ, and to a considerable extent weakens the column. The advantage of laminectomy is that it removes pressure from structures, each fibre of which is necessary for vital function, while in the brain individual cells are not so essential. While asepsis has greatly diminished the dangers of the operation, yet in a certain number of cases laminectomy opens the way for spinal infection, and the results of the pachymeningitis remain or are increased. Fortunately, the pachymeningitic deposit in some cases will be found localized and can be removed. If the bony angulation with pressure in front of the cord were the chief cause of the loss of

motion and sensation in the lower extremities it would certainly be wiser to push our operative results to a greater degree, even to the extent of severing the spinal nerves in order to reach the source of trouble in front of the cord and then to reunite these nerves. An immediate mortality of 25 per cent. is very high, especially in a disease which is not in itself necessarily fatal, particularly as this rate is augmented during the first month by other deaths reaching more than one-third. If to this mortality be added those late deaths that are not directly the result of the operation, yet follow within a year, we find that in at least one-half of the cases life has been shortened. Final results following laminectomy are exceedingly difficult to obtain, since caries is a disease in itself, one that has to be judged by years not months, and an early report is valueless. The published reports would indicate that 65 per cent. may reasonably be placed to the credit either of deaths or of not having been materially or permanently improved. Naturally, however, these patients were all serious cases at the time of operation.

A few words in regard to technique. Incision to one side of the dorsal median line, and the cutting off of spinous processes and pushing them to one side lessens hemorrhage. Hemorrhage and removal of the first laminal arch constitute the delays in the operation. Many hemostats and very hot packing should be at hand. Many surgeons prefer cutting bone forceps for taking away the first arch. I use either gnawing forceps or a Heys saw. The fatty tissue and the ligament subflava are at first confusing, but as soon as the cord is exposed all hesitancy disappears. If the dura is yellow there is probably pus within the membrane. A surgeon who has performed the operation only once or twice upon the upper portion of the spinal column realizes but little the difficulties and dangers of the procedure in the lower column. One danger of the operation is that blood leaking into the canal may cause additional compression and paralysis by travelling down the subdural space. Postmortems show that similar extravasations of blood may take place on the cornua or on the columns, producing further paralysis. After secondary degenerations have taken place improvement in the paralysis is not to be expected. One of the great dangers of laminectomy, especially low down, is the risk of

later infection from bed-sores or from pus sinuses. The neuropathic bed-sores are especially dangerous from the extent of the trophic changes, while leakage of infected and decomposing urine is also most serious. Laminectomy is much less hopeful in spinal caries than in fractures and other traumatisms, since pachymeningitis, compression myelitis, or meningomyelitis may all be present in the former. All undue handling, even sponging of the cord, adds to the shock. The cord may be rolled to one side, but any extensive bone erasion is to be accomplished from the side, not across the cord space. If nerve roots are injured they should be sutured. When the extradural deposit is considerable and its removal possible the dura should not be opened, as any fissure in this membrane is liable to permit tuberculous infection within the membrane. To sum up, then, the dangers of laminectomy are its high mortality from shock and hemorrhage, infection, suppuration, extension of myelitis or pachymeningitis, failure to permanently relieve, and weakening of the column.

The advantages are the removal of tuberculous masses in the canal, the removal of pachymeningitic deposits and of pus, the relief occasionally of anterior bony pressure, and lastly, allowance for posterior expansion. In some instances marked benefit results both as regards motion and sensation. Relief of vesical symptoms alone gives great comfort.

2. *Forcible Immediate Correction of Kyphosis.* The method of immediate forcible straightening of the spine by hand pressure, the patient lying prone with pelvis and shoulders elevated upon blocks, revived by Calot, is simply a new form of the barbaric methods practised before the time of Hippocrates. In those days a man's feet were bound to a ladder and he was then dropped head downward from the top of a building. In other cases a long beam was used as a lever with the kyphotic spine as the fulcrum, by which method, of course, it was easy to crush any amount of deformity into the straight line. Hippocrates states that this method was employed "by those physicians who seek to astonish the mob and never give themselves any concern as to the result of the procedure, whether good or bad."

Looking at the operation both pathologically and clinically, it is unsurgical and unscientific. Upon its revival I preferred that

other surgeons should try it rather than myself, and I have never had occasion to change this opinion. I have resorted to the procedure a few times in old hopeless cases, but the operation has died the death to which it was entitled. To break up an already ossified bridge and leave a carious gap certainly is not conducive to the strength of a column; if pus is present infection is probable. It has been shown pathologically that the material thrown out in the process of repair does not contain sufficient calcium salts or bone-producing material to give proper strength to the new bone. Since a cure can only be expected by an ossifying ostitis and a fixation of the spinal column capable of sustaining the superincumbent weight of the shoulders and head the effort aimed at should not be, as in the immediate forcible operation, to produce a gap in the front of the spine, which experience has shown can never be fully filled, but to secure as large an amount of ossifying material as possible and a bridge of most secure pattern. While the muscles may for a time hold the spine in position, they must ultimately give way and relapses continue after the removal of the support.

Cases in which advantage has been secured in the relief of paraplegia are undoubtedly where the cord pressure has been relieved by the altered straightening of the column; the disadvantages are insufficient support, causing weakness of the spine; subsequent recurrence; dissemination of tuberculous material; increase of disease by local injury; production of general tuberculosis; injury to the cord; fresh suppuration. In some cases the paraplegia has been rendered worse, and in one instance the wall of the abscess was ruptured sufficiently to admit tubercle bacilli into the mediastinum.

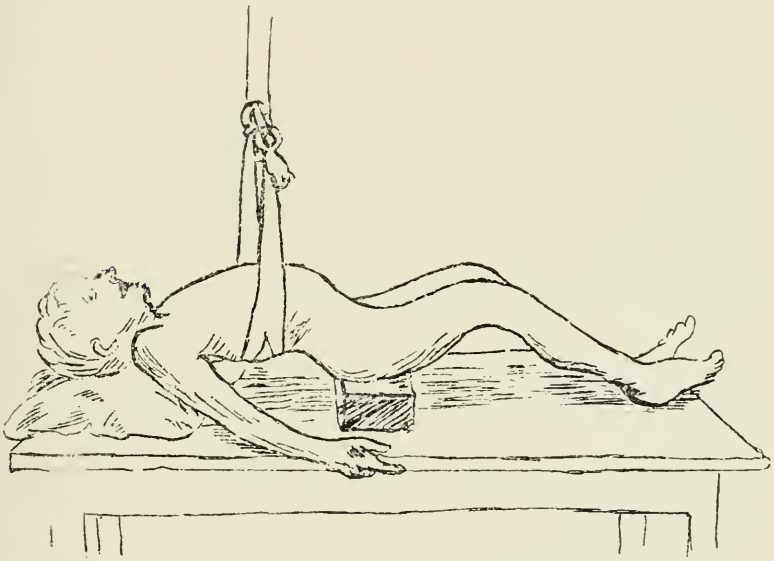
3. *Gradual Correction of the Deformity.* Forcible hand pressure upon the kyphosis at varying periods or by using the hump as a fulcrum and bringing to bear upon it the weight of the body above and below the disease is a much safer process than immediate fracture. The advantage gained by such straightening must be immediately fixed by the application of a plaster-of-Paris cast. By this method a small amount of gain is secured, but all that is justifiable or to be expected safely. It is undoubtedly true that a large proportion of so-called straightening of the spine is due not

to actual improvement of the kyphosis, but to the alteration of the curves in other portions of the column. The forced lordosis bringing the weight of the body upon the posterior arches rather than upon the bodies is probably a large element in the benefit secured. This is true whether suspension is used or whether the dorsal fulcrum is applied directly to the kyphosis. The recumbent position upon a curved frame and extension in bed with a pad under the kyphosis during the acute stage is the best method of preventing deformity. Then fixation for a long period of time by some form of splint adapted to each particular region of the spine, that is, in the cervical region the head should be thoroughly splinted, not by suspension or by a jury-mast, but by prolongation of the steel uprights, so as to hold the head firmly in position with rigid splints. In the upper dorsal the same method is necessary; in the lower dorsal or lumbar either a steel or leather or similar jacket may be employed. Success depends upon the careful and long continuance of retention appliance for a sufficient length of time to produce a strong bony ridge. With the screw elevation shown in Fig. 1 the kyphosis and the spinal column are forced into hyperextension while the gypsum is applied. The plate over the hump is protected by a large loose felt-cloth pad, which remains. Before the plaster fully hardens a slit is made over the plate, which is so hinged that it can be withdrawn through a small opening. This opening can be closed at once by patching with plaster. A muslin suspension sling answers a similar purpose (Fig. 2).

4. *Erasion of Carious Bone.* Theoretically the operation of erasion is a good one; practically the anatomical difficulties encountered are well-nigh prohibitive to that absolute removal of all carious tissue which is so essential to a complete and rapid diminution of pus formation. Of course, as long as we have any dead bone remaining the discharge will continue. If the disease were situated principally or simply in the posterior regions, of course removal would be easily accomplished, but since it is the bodies of the vertebræ that are chiefly diseased the absolute removal of all diseased tissue is problematical. The bodies of the lumbar vertebræ are large and lie far from the surface of the body; a careful inspection is impossible, and manual palpation fails to discern diseased bone from the roughened surfaces left in cancellous

tissue by a gouge. One has but to examine a cross-section of a body, as seen in formalin or frozen sections, to note the difficulties of completely reaching and removing the entire body of the vertebræ, even in a cadaver. In the dorsal region still greater difficulties are encountered. To reach the bodies, portions of ribs must be excised, a costotransversectomy; the pleura lies in close proximity and the wounding of this membrane opens new avenues for infection. The operation of erasion in this region is only appli-

FIG. 2



Muslin bandages for temporary suspension during application of gypsum. (Bradford.)

cable in cases where a large intrathoracic abscess has pushed the pleura forward and where manipulations can be conducted from inside the sac, a condition difficult to diagnose in advance. The twelfth dorsal can be reached from below through the psoas, but it should be remembered that the pleura is close at hand; sometimes extends as low as the liver and the transverse processes of the first lumbar. In the cervical region a certain amount of diseased bone may be removed, but seldom all. In all these regions, therefore, the results are uncertain. The *x*-ray may assist in locating the

disease, but even taken in connection with clinical symptoms is not positive. In the lumbar region too long an operation is not advisable, as the multitude of muscles, tendons, and strong fasciæ render the operation difficult, bloody, and uncertain. The immediate risks of the operation are considerable. To a certain extent, however, the suppurative process may be shortened by the amount of dead bone removed; the chief advantage gained is drainage.

5. *Wiring of the Spinous Processes.* Wiring of the spinous processes as a means of inducing fixation of the column has been occasionally used, but not with sufficient frequency to determine its usefulness. Theoretically and mechanically the method seems only fairly helpful.

6. *Evacuation of Pus Accumulations.* Surgeons vary in their methods of dealing with pus accumulations from spinal caries. Some still insist that cases progress more rapidly if the abscess is permitted to remain quiescent and to be absorbed or encapsulated. In some instances such a result is undoubtedly possible, but it is risky and usually unsuccessful. My own practice is to aspirate such accumulations so long as the liquefaction of caseation is drawn, but when the suppurative process is added to the tuberculous, aseptic through drainage from spine to groin is best, provided subsequent cleanliness can be secured, a result which is undoubtedly possible with the exercise of constant vigilance.

Conclusions. 1. Complete methodical and long-continued fixation of the spine in the position of hyperextension, with healthy surroundings in the sunlight, are the prime factors in securing new ossific deposit necessary to replace the carious bone.

2. Laminectomy for paraplegia is advisable only after long-continued and patient treatment along the above-named lines from one to two years, since the prognosis, especially in children, under these conditions is favorable and good powers of locomotion may be confidently expected. The operation is justifiable in selected cases where loss of motion and sensation are progressively worse and the symptoms threaten life. If the tuberculous masses within the spine can be removed and if extradural pachymeningitic deposits or pus can be taken away, improvement may be expected and in many cases relief occurs. The operation has a mortality of about 25 per cent. from immediate shock; 36 per cent.

within a month, while one-half the cases die within the year, their lives being probably shortened by the operative procedure. Cases of non-improvement and death equal nearly 65 per cent.

3. Forcible immediate straightening of the kyphosis is an unsurgical and dangerous proceeding; it is liable to reawaken the tuberculous disease and to weaken the column.

4. Forcible gradual straightening by supporting the kyphotic area upon a pedestal is a valuable agent in relieving deformity. The weight of the shoulders and pelvis can thus be utilized as straightening forces and the weight of the column thrown upon the posterior arches. In this position it is permanently fixed by plaster-of-Paris.

5. Complete erasion of the carious bodies of the vertebræ is an uncertain operation; in the dorsal region requiring section of ribs with danger of wounding the pleura.

6. Wiring of the spinous processes has never been sufficiently tried to demonstrate its helpfulness.

7. Spinal abscesses which contain only liquefaction of caseation should be aspirated. When true pus has formed aseptic through drainage from spine to groin is advisable.

# THE SURGICAL TREATMENT OF INTRASPINAL TUMORS.

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Among the many fields of surgical activity which owe their present advanced state largely to the labors of physicians, few have owed so much in the past or still owe so much to them as that of spinal tumors, although to a surgeon—von Leyden (1874)—is due the first suggestion of an operation for the amelioration of the symptoms produced by this disease. Nor, I think, would any surgeon presume at the present day to perform laminectomy for a suspected intraspinal growth without consulting a neurological colleague, even were the surgeon himself capable of diagnosticating and of accurately localizing the tumor. It is, therefore, not the purpose of the present paper to treat at length of the symptoms and diagnosis of these affections; it is quite sufficient to recall briefly the salient features which would in the case of any patient suggest to the surgeon a neurological consultation.

Pain is usually the symptom first complained of, and is generally of a rheumatic or neuralgic character, localized to one limb, or to certain of the intercostal nerves. It is frequently more or less completely relieved temporarily, but persistently returns, and constantly grows more severe. To the pain is next added—often, however, not for some years—a numbness and heaviness in one or more of the limbs. The symptoms are almost invariably unilateral at first, but with equal constancy become bilateral before paresis has fully developed. Girdle sensation, with a zone of hyperæsthesia immediately above the limit of the anæsthetic area, is also usually observed. Early in the course of the disease the affected limbs are spastic, but later the reflexes are lost, and

in time the muscles lose their reaction to the faradic and to the galvanic current as well. The loss of certain of the sensations, as those of heat and cold, while others are retained, considered characteristic of syringomyelia, is also sometimes observed in tumors pressing on the spinal cord; and several instances are known where operations, undertaken for the removal of supposed spinal tumors, have relieved, at least temporarily, the syringomyelic symptoms by the evacuation of the cystic collections found in this disease. Local physical symptoms of a tumor are usually absent—such symptoms, for example, as deformity and rigidity of the spinal column, or tenderness on pressure over the site of the tumor; but when such symptoms are present they are, of course, a considerable aid in diagnosis, when tuberculous caries of the spine can be excluded.

The science of spinal localization is now so well developed that it usually is not difficult to determine with accuracy the location of an intraspinal growth; and since multiple growths are exceedingly rare, the chances for successful removal of a spinal tumor would be overwhelmingly favorable did success depend upon localization alone. But besides this factor we must also consider the inherent difficulties of the operation, the nature of the tumor, and its relation to the membranes of the cord.

In searching the literature for reports of operations for tumors of the spinal cord, a number of cases have been found which do not strictly come under this classification. What is usually understood by the term tumor of the spinal cord, is an extramedullary but intraspinal growth like a sarcoma, a fibroma, or a myxoma, giving no evidence of its existence except by the symptoms of medullary pressure which it produces. Thus, tumors of the spinal column—osteomata, enchondromata, or sarcomata—which are palpable externally, and are readily diagnosed by an ordinary physical examination, should not be included unless by extension into the vertebral canal they produce medullary symptoms. Cases of pressure on the cord due to traumatism, or to tuberculous caries of the spine, are also, of course, excluded. But I have included in my tables certain cases in which, although there were present external symptoms of the growth, there was nevertheless no direct connection between the two. For instance, a case reported by

Curtis, in which laminectomy was done for spinal involvement secondary to carcinoma of the breast, has been included, although such extension of malignant growths is not very unusual,[1] and although such cases do not strictly belong to the class of intraspinal tumors. No cases have been included, however, in which laminectomy was a mere incident in the removal of a growth extending into the spinal canal, but in which it was an operation not intentionally undertaken to relieve the symptoms of spinal irritation.

There have been found records of 92 operations for spinal tumors, among which number 43 patients died—a total mortality of nearly 47 per cent. McCosh has stated[2] that the mortality of laminectomy *per se* should not be more than 10 per cent.; and if from the percentage above given we omit those cases, 17 in number, ultimately known to be fatal, but in which death ensued some weeks or months after the operation, we can reduce our mortality to 26 cases, or 28 per cent. Even with a mortality of nearly 30 per cent., it does not seem to me that the surgeon should hesitate to operate in these cases, since even when a cure cannot be obtained, relief from the pain is almost invariably secured, and the patient in most instances lives as long as he would have done if no operation had been performed.

The nature of the tumor is recorded in 88 of the reported cases. It was sarcomatous in two-fifths of the whole number (37 cases);[3] adhesions, thickenings, etc., hold second place, with 11 cases; then comes echinococcus, 8 cases; fibroma, 6 cases; syringomyelia, 5 cases; endothelioma, 4 cases; psammoma, 3 cases; cyst, 3 cases; fibromyxoma, 2 cases; osteoma, 2 cases; and one each of myeloma, lipoma, lymphangioma, dermoid cyst, primary and secondary carcinoma, and one tumor of bone whose nature is not stated. In only three instances where the patient recovered from the operation did no improvement follow it. Two of these were cases of inoperable sarcoma, and the third was a case of syringomyelia.

[1] C. N. Dowd (New York Medical Record, 1898, vol. i. p. 347) collected histories of 29 cases of mammary carcinoma, in 5 of which there had been distinct symptoms of involvement of the spine.

[2] Journal of the American Medical Association, 1901, vol. ii. p. 621.

[3] Of Schlesinger's 400 cases of spinal tumors, one-quarter were sarcomatous

The annexed table shows that of those patients, 49 in number, who survived the operation for some weeks or months, no less than 29, or 59 per cent., recovered their functions sufficiently to be classed as cured; that 17, or 34 per cent., could be classed as improved by the operation; while in the condition of only three patients, or 6 per cent., as mentioned above, did the operation effect no change.

| Variety of growth. | Total. | Died. | Recovered. | | |
|---|---|---|---|---|---|
| | | | Cured. | Improved. | Not improved. |
| Sarcoma | 37 | 20 | 8 | 7 | 2 |
| Adhesions, etc. | 11 | 5 | 4 | 2 | 0 |
| Echinococcus | 8 | 3 | 5 | 0 | 0 |
| Fibroma | 6 | 2 | 3 | 1 | 0 |
| Syringomyelia | 5 | 2 | 0 | 2 | 1 |
| Endothelioma | 4 | 2 | 1 | 1 | 0 |
| Psammoma | 3 | 1 | 1 | 1 | 0 |
| Cyst | 3 | 0 | 2 | 1 | 0 |
| Fibromyxoma | 2 | 1 | 1 | 0 | 0 |
| Osteoma | 2 | 0 | 2 | 0 | 0 |
| Tumor of vertebra | 1 | 1 | 0 | 0 | 0 |
| Myeloma | 1 | 0 | 0 | 1 | 0 |
| Lipoma | 1 | 1 | 0 | 0 | 0 |
| Lymphangioma | 1 | 0 | 1 | 0 | 0 |
| Primary carcinoma | 1 | 1 | 0 | 0 | 0 |
| Secondary carcinoma | 1 | 1 | 0 | 0 | 0 |
| Dermoid cyst | 1 | 1 | 0 | 0 | 0 |
| Not stated | 4 | 2 | 1 | 1 | 0 |
| | 92 | 43 | 29 | 17 | 3 |

49 recovered.

In discussing the sarcomata recorded here, it may seem audacious in the extreme for a surgeon to mention such a thing, but it does not seem impossible to me that in some instances the microscopic diagnosis may be in error. It certainly appears from this table, where 17 out of 37 sarcomatous patients are reported as having recovered from the operation, that sarcomata of the spinal canal do not possess that extreme malignancy which characterizes them in other parts of the body. When three such patients are reported as in fair health at a period of more than six months after the operation, and five are said to be well at the end of from two and a half to five years after the operation (of

which latter cases two patients, surviving more than four and five years, respectively, had intradural sarcoma), it makes one very skeptical as to the reliability of histological diagnoses. Some of these cases are reported as having an infiltrating sarcomatosis, practically inoperable; yet after cautious curettement of the external surface of the diseased dura no recurrence is noted even when years have elapsed. Cushing's case is reported frankly enough as one in which reasonable doubt existed as to the diagnosis between fibrosarcoma and fibroma; and McCosh likewise states that in view of the subsequent history of his patient (no recurrence after two and a half years) it is probable that the tissue removed at operation was granulation tissue and not sarcomatous in character. But other observers, especially the German surgeons, do not seem to have been struck by this point. We all know with what melancholy regularity sarcoma recurs in amputated stumps and in extirpated glands; but when it occurs along a man's spinal marrow it seems that we may expect its removal to ensure against recurrence in nearly or quite half of the cases.

I have included in the table twelve operations where symptoms of spinal tumor were produced by meningeal thickenings or adhesions. In at least 5 of these cases (Macewen's) the patients had suffered from Pott's disease of the spine in previous years, and a kyphosis still remained; but no tuberculous process was found at the operation, and with Starr's tables[1] of spinal tumors as my authority, I have thought it proper to include them with tumors rather than among cases of laminectomy for spinal caries. I have myself recently done the operation of laminectomy on a patient with old Pott's disease, in whom no active bone disease was found, but in whom the paralysis appeared to be due to extradural thickening, and not to actual compression from the angulation of the spine.[2]

*Paraplegia from Pott's Disease; Laminectomy; Great Improvement.*—Harry S., aged twenty-six years, was admitted to the Orthopædic Hospital, Philadelphia, September 5, 1904. There was no tuberculous family history obtainable. The patient had had pneumonia at two years, scarlet fever at five years, and

[1] American Journal of the Medical Sciences, 1895, vol. ciii. p. 613).

[2] Since the publication of this case the patient has left the hospital, walking as well with crutches as the average man with one leg.

diphtheria at seven years of age. In 1896, when nineteen years old, he had typhoid fever, which was complicated by phlebitis in both lower extremities, the right being the first affected. After about three months of convalescence his legs ceased to swell. In 1898 he entered the army, and fell and struck his left knee-cap. The injury was not severe, but there was much swelling and a good deal of pain. For this condition he was admitted to the Pennsylvania Hospital June 29, 1898, under the care of the late Prof. Ashhurst. The diagnosis was tuberculous arthritis of the left knee. In July some iodoform emulsion was injected into the joint. In August an abscess, apparently tuberculous in character, formed on the inner middle aspect of his right arm. This was opened and drained. In September, 1898, the patient was discharged from the Pennsylvania Hospital, walking with crutches. Six months later, in May, 1899, he returned to the Pennsylvania Hospital for examination, and was under my care. His limb was in good condition, and he had a fairly useful knee. He was allowed the use of his leg. After this date he states that the abscess on his arm opened again, and that his shoulder became stiff. In 1901 he was again admitted to the Pennsylvania Hospital, and the knee-joint was found so badly diseased that it was thought impossible to further pursue conservative treatment. Dr. Barton Hopkins accordingly amputated the left thigh in its lower third. The patient made a good recovery from the operation, and returned to his home in Harrisburg. Not long after this date he noticed a hump the size of a hickory-nut in the lower dorsal region of his spine. He complained chiefly of pains in the lumbar region, and was treated for lumbago. He was not seriously incommoded, however, until June, 1904, when he suffered from what he describes as "remittent fever," being confined to bed for two weeks. When he got out of bed he noticed that a numbness which he had felt for some months around his hips had increased, and also that his foot was numb. He very soon lost the use of his body and limbs below the waist line.

On admission to the Orthopædic Hospital, in the autumn of 1904, he was paralyzed from the waist down, and sensation was markedly impaired throughout the affected area. He had retention of urine and a severe grade of cystitis. The stump of his amputated left thigh was in good condition. There was very marked

kyphosis in the lower dorsal region. Extension was applied to his head and his right leg, and measures were adopted to relieve the cystitis. Sensation improved somewhat, and the cystitis was finally cured, and the patient regained control of his bowels and bladder. He also became able to flex the great toe occasionally, and by contracting his abdomen and psoas muscles he could barely move both thighs. He remained in this state for many months, and as no further improvement seemed probable, the question of laminectomy arose. He was examined by one of the neurological staff, who advised against any operation. Nevertheless, on April 27, 1905, nearly eight months after his admission, laminectomy was undertaken, the patient being willing to undergo any operation that offered him even the remotest chance of improvement. A cure was not anticipated. The spines and laminæ of the ninth, tenth, and eleventh dorsal vertebræ were removed, and some extradural thickening dissected out. Practically no shock attended the operation, and on recovery from the anæsthetic the patient expressed himself as being able to feel the bed under him in a much more real way than he had done before. He said he no longer felt dead below the waist. Gradually increasing power in the great toe developed, and at the end of four weeks sensation was perfect all over the lower extremities, all the toes could be freely moved, the ankle-joint could be flexed and extended at will, the knee and thigh could be raised from the bed, and the amputated thigh could likewise be moved. Before the operation, when one or two movements of the great toe had been made, all power was exhausted, and no further motions could be made for some hours. Now he can move his muscles at will all day long.

With very few exceptions it is impossible to determine the nature of the tumor before operation; gummata may nearly always be excluded; they are very rare in the spinal canal, and it is never worth while to delay operation for the sake of trying antisyphilitic treatment. According to Starr[1] only 26 gummata were found in a series of 400 cases of tumor of the spinal cord. Sarcoma can only be diagnosed with certainty when the spinal lesion is clearly secondary to similar disease elsewhere in the body. The only other tumors found which are frequently secondary in origin are

[1] Journal of the American Medical Association, 1901, vol. i. p. 202.

hydatid cysts. Among the eight recorded operations for this condition, three were palpable over the spinal column, and one of these (Trendelenburg's) was reoperated after four months for recurrence.

In a case recorded by Hale White,[1] Fripp operated twice on a young man with spinal pressure from a dermoid cyst in the upper dorsal region. Although on the first occasion the growth was found to be inoperable, yet so much relief was experienced for a period of two months that another attempt was made to relieve the patient, but unfortunately without success, as the case terminated fatally in eight and a half hours. This young man had suffered from Hodgkin's disease for a number of years, but it was clear even before the first operation that the spinal pressure was unconnected with that condition. In the autumn of 1904 I operated on a case of dermoid cyst of the spine, and although there were no symptoms of involvement of the spinal cord, I desire to place it on record.

*Dermoid Cyst of the Spinal Canal; Operation; Recovery.*—E. T., a girl, aged seven years, was admitted to the Episcopal Hospital, Philadelphia, August 31, 1904, under the care of Dr. H. C. Deaver. She presented a diffuse swelling over the sacrum, cystic and semi-fluctuating to the touch, and extending well over to both buttocks. This condition had existed since birth, and had been considered a spina bifida. A few days before admission she had been struck over the tumor. A small abscess formed, and was opened September 13, 1904, being apparently superficial, and not connected with the spinal tumor. She was discharged from the hospital on September 22d, but was readmitted on October 3, coming then under my care, with high fever, and evidences of infection of the spinal growth. After appropriate local and general treatment, which caused subsidence of the constitutional symptoms, it was determined to attempt the removal of the spinal tumor, which produced great deformity in the child, as well as interfering with her sitting comfortably on a chair. Accordingly, on October 21, 1904, I dissected the cyst out, finding it adherent to the coccyx and the lower sacrum. Part of the coccyx was removed. The wound healed uneventfully, though slowly, and the patient was discharged, cured, February 2, 1905. The appearance of the

[1] Transactions of the Clinical Society of London, 1900, vol. xxxiii. p. 140.

growth at operation was typical of dermoid cyst, and the pathological report confirmed the diagnosis. "The section is undoubtedly tissue from a dermoid tumor in which the connective tissue predominates. There are small areas of epithelial structures, such as serous glandular tissue and extensive areas showing mucosa and submucosa, with solitary follicles and agminated lymph glands. There are numerous bloodvessels and scattered foci of hemorrhagic infiltration; considerable fatty tissue; little smooth muscle, but no voluntary muscle."[1]

It has usually been stated that extradural tumors were much more frequent and much less fatal than intradural growths. I do not find this to be the case, however. There are 87 cases in which the situation of the tumor with regard to the dura is mentioned; in 51 of these it was extradural, and in 36 intradural—not such a very striking difference. The death rate, moreover, in the extradural cases was even higher than that of the intradural tumors, being 50 per cent. for the former and only 47.21 per cent. for the latter. This may perhaps be explained by the fact that sarcomata are more frequently extradural than intradural (of 37 sarcomata 16 were intradural and 21 extradural), and that they are also more apt when intradural to be circumscribed or encapsulated, and thus removable with little damage to the surrounding parts; whereas, the extradural sarcomata are frequently infiltrating, and may involve the spinal column and surrounding muscles very extensively. Nevertheless, the danger attendant upon intradural operation must not be ignored, since we find that among these operations, all done with antiseptic or aseptic precautions, no less than six of the intradural terminated fatally from meningeal infection, whereas only one of the fatal extradural cases has meningitis recorded as the cause of death.

Malaisé[2] has recently written an elaborate article on the diagnosis between intra- and extramedullary tumors of the spinal cord, but in no case reported to-day was it possible to tell before operation the relation of the growth to the dura, much less the fact whether it was in the substance of the cord or not. In only two of these cases (except, of course, those of syringomyelia) was it found at

[1] In connection with the subject of dermoid cysts of the spine, see an interesting article by Bland Sutton in the Annals of Surgery, 1889, vol. ii. p. 81

[2] Deutsche Archiv. f. klin. Med., 1904, Band lxxx. p. 143.

operation that the medullary substance was involved in the growth. These were Fenger's case of spindle-celled sarcoma and Warren's case of endothelioma. The former terminated fatally on the fourth day from septicæmia, but Dr. Warren's patient was in good health more than one year after the operation.

It is interesting to note that among female patients the mortality of operation has been only 45 per cent., while among the male it is 57 per cent. In searching for an explanation of this marked difference, I have noticed that sarcomata were found one-third oftener in males than in females, and suppose that this fact may have something to do with lessening the mortality among women.

Most of the operations were on adults, nearly one-half being between thirty and fifty years of age. The extremes of life were nine years in a boy and sixty-five years in a woman. Those patients under twenty and over fifty gave the highest percentage of recoveries.

The average duration of symptoms before operation was two years and three months. In 12 patients symptoms had existed for less than six months, in 11 for one year, in 8 for one year and a half, in 12 for two years, in 11 for three years, in 7 for four years, and in 6 for periods varying from four to eighteen years. The duration of symptoms does not, unfortunately, throw much light upon the nature of the tumor, since I find that the average duration of symptoms in the patients with sarcoma was two and three-quarter years, in those with adhesions two and three-quarter years, in those with echinococcus two and one-half years, and in those with fibroma one and a half years; while in all other forms of growth the average was about two and one-eighth years.

A history of injury is noted in only 5 cases—three sarcomata, one each a psammoma and an endothelioma.

Of 82 cases in which the region of the spine affected is given, the upper dorsal region was involved in 33 cases, or over 40 per cent.; the tumor was found in the lower dorsal region in 24 cases, in the lumbosacral region in 14, and in the cervical region in 11 cases. As far as the results are concerned it appears to be immaterial at what level the growth is found.

The cause of death is given in 28 cases. One-half of these were due to shock and hemorrhage, or to infection and meningitis, there being 7 fatal cases under each of these categories. Eight

patients died from exhaustion, 3 from recurrence of malignant growths, 2 from hypostatic pneumonia, and 1 from bed-sores and sepsis.

As regards the technique of the operation it is essentially the same as when employed in traumatic cases. The patient lies in the prone position, with a sand pillow or other firm support beneath his shoulders and upper chest, so as to raise the diaphragmatic region somewhat away from the table; this position facilitates the operation by rendering the respiration of the patient less labored, as well as by making the spine more accessible. As has been repeatedly demonstrated at operation and autopsy, the inclination of the surgeon is to search for the growth too low down in the spinal canal. Horsley says it may be expected to be found four inches above the upper limit of the hyperæsthetic zone. In the cases tabulated in this paper, the growth was not found in 5; and in 3 of these it was proved, either at a second operation or at autopsy, that it could have been easily removed at the first attempt, had the exploration of the spinal canal been carried higher. Some surgeons have advocated beginning the laminectomy some distance above the supposed location of the growth, and then working downward, thinking that the wound would heal better thus than when the spine was explored from below upward, because by the latter procedure the parts divided have their nerve supply impaired by the more highly situated lesion. But it seems to me that it is much more in accord with surgical principles to begin our operation where we expect to find the tumor, and to subsequently search the spinal canal higher up, if we fail to find the compressing structure where it is believed to be.

The incision should be made on the tips of the spinous processes, and should be amply large to expose at least three vertebræ. I have never employed osteoplastic resection of the arches, known in Germany by Urban's name, and do not think it is a good form of operation. Sonnenburg condemns it, and attributes the death of one of his patients from meningitis on the eighteenth day to the presence of the retained bones. Nor do I think the plan advocated by Abbe[1] a commendable procedure. This surgeon makes his incision one-half inch to the side of the spines, then

[1] New York Medical Record, 1890, vol. ii. p. 85.

chips them off just below the interspinous ligament, and turns them back with the soft parts as a flap on the other side of his wound, and then proceeds to do his laminectomy. For my own part I think it better to cut right down on the spines, and then clear the laminæ on each side with the scalpel and periosteal elevator. The bleeding during this process is always free, and can only satisfactorily be controlled by packing. Hæmostatic forceps will not hold in the fibromuscular tissues of the spinal gutters. It is most convenient, therefore, to pack one side temporarily while the other is being cleared, and then to pack the second side and return to complete the clearing of the first. By this means little blood is lost, and by the time the spines and laminæ are cleared the bleeding will have nearly ceased, without the employment of forcipressure, and without the application of a ligature. I have not found transverse division of the spinal aponeurosis at each end of the incision necessary to facilitate the retraction of the flaps; but it may be employed if preferred.

In the dorsal region, where the spines overlap each other, the next step is to cut off two or three spines at their base with large butcher's knife-bladed forceps. It is impossible to insert a forceps between the laminæ until the spines are out of the way. When this is accomplished it may be possible to bite through the bases of the laminæ, next the pedicles, with large knife-bladed forceps. The blades should be set nearly at right angles with the shaft, the angle being on the edge, as in bandage scissors, not on the flat as in the ordinary curved scissors. If such forceps are not at hand, or if they cannot be made to bite through the laminæ, I prefer to apply a crown trephine to the base of one of the spinous processes, and thus open the spinal canal. The trephine should be at least a half or three-quarters of an inch in diameter. When the canal has once been entered, the opening may be enlarged with rongeur forceps. I do not think the use of chisel and mallet (a gouge is safer) advisable, as a rule, but have at times found them useful in trimming off the ragged margins left by the rongeur forceps.

Hemorrhage from the spinal veins may be controlled by gauze packing or by Horsley's wax, which should always be at hand.

The condition of the dura should next be examined. A considerable amount of connective tissue may overlie it, and removal

of this alone may be sufficient to relieve all symptoms, if no other cause of compression can be found. The dura should pulsate, and normally bulges somewhat into the wound, occluding the extradural space at the limits of the opening made into the bony canal. It is well to be quite sure that no extradural cause for compression exists before proceeding to open the membranes, since the risks of producing meningitis are thus considerably increased. Horsley's dural separator is, I think, the most convenient instrument to use in exploring the spinal canal beyond the limits of the wound. Krause[1] uses a thick sound to explore when the tumor is not found immediately beneath the opening in the spinal canal. If nothing can be detected by means of cautious exploration in this manner the dura may then be opened in the median line. The incision should be made with a scalpel hitherto unused in the operation, and the same precautions to avoid injuring the cord are to be used that we employ when opening the peritoneal cavity to guard against injury of the intestines. The opening first made should be small, and the escape of the cerebrospinal fluid, which may prove a veritable flood, should not be allowed to take place too rapidly. No alarm need be felt at the quantity of this fluid evacuated, since, so far as I am aware, no evil results have been known to follow the plan usually adopted, of letting it run until it stops of its own accord. In an operation on the cervical region Woolsey[2] packed the subdural space at the upper end of the wound with gauze, to check the flow of cerebrospinal fluid before the operation was proceeded with; and he mentions the plan adopted by Schede of encircling the cord above and below the seat of operation with an extradural temporary ligature; but most surgeons have not been forced to adopt such measures to check the ooze.

The opening in the dura is then to be enlarged with scissors to the full extent of the laminectomy wound, and the search for the tumor continued. Almost invariably the tumor, whether intra- or extradural, is found to one side or other of the cord, and nearer its posterior than its anterior surface; but if it is not detected in these situations the anterior surface of the cord may be cautiously explored with an aneurysm needle.

[1] Deutsche med. Woch., 1903. Band xxix., Ver.-Beil. 321.
[2] New York Medical News, 1904, vol. ii. p. 625.

If a cyst is found it should be punctured, and, especially in the case of hydatid cysts (which in all the cases here recorded were extradural), great care should be taken to prevent spread of infection. As a rule, the intradural tumors are found to be more or less encapsulated, and may be removed with only trifling hemorrhage.

If no tumor can be found in the region of the spinal cord exposed, the surgeon should not hesitate to remove the spines and laminæ of three, four, or five of the vertebræ higher up. The chances of an error in diagnosis having been made are much less than those of failing to find the tumor through timidity of exploration. Of course, in these, as in all other cases, the extent of the operation must be governed largely by the condition of the patient; and in case of collapse of the patient the operation should be temporarily abandoned and concluded after a day or two, if possible, when reaction has occurred, as was done in one case by McCosh, with the result that the tumor was found and removed at a higher level than that exposed at the first operation.

Where no cause for the symptoms can be found it is at least possible to divide the posterior roots of the affected nerves, and thus promote euthanasia.

If the dura has been opened, it should be sutured, if at all, very loosely. These patients have done much better when the drainage of cerebrospinal fluid after the operation has been free. Fine catgut is better than silk for the dura, as it is less liable to cause a persistent sinus. Drainage with gauze down to the dura should, I think, be employed in every case. The wound of the soft parts is extensive, and the traumatism will have been considerable, and unless free exit is given to the wound discharges suppuration is quite apt to ensue. The gauze may be removed on the fourth or fifth day, or as soon as the patient is able to bear the necessary disturbance. The spinal aponeurosis should be brought together with buried sutures of chromicized catgut, and the skin should be approximated with interrupted sutures of silkworm-gut, not too closely applied.

After the operation no rapid improvement in the patient's condition need be anticipated; indeed, the paralysis and the anæsthesia are sometimes markedly aggravated by the interference with the spinal nerves. But the pain is nearly always remarkably

relieved, and the patient is in a more hopeful frame of mind than before the operation.

The after-treatment should be the same as in every serious operation. Calomel and Dover's powder, as in head injuries, will be beneficial to obviate the tendency to restlessness and wakefulness. The period of rest in bed must vary somewhat with the strength of the patient and with the extent of the operation. Some patients can be allowed to get out of bed in less than a week; but, as a rule, they should maintain the recumbent position for from three to five weeks. When the patient first gets out of bed his back should be supported in a spinal brace or a plaster cast; and for the partial paralysis of his limbs, which sometimes persists, such orthopedic appliances should be ordered as may be required.

### List of Cases Analyzed.

1. Abbe. Journal of Nervous and Mental Disease, 1903, vol. xxx. p. 103. Variety of growth not stated; recovered.

2. Abbe, Thorburn. British Medical Journal, 1894, vol. i. p. 1403. Syringomyelia; no improvement.

3. Abbe, Starr. New York Medical Record, 1890, vol. ii. p. 85. Case VI., sarcoma; died.

4. Abrahamson. Journal of Nervous and Mental Disease, 1903, vol. xxx. p. 102. Not stated; died.

5. Anderson, Ransom. British Medical Journal, 1891, vol. ii. p. 1144. Echinococcus; died.

6. Barclay, Clarke. Brain, 1895, vol. xviii. p. 256. Endothelioma; died.

7. Bottomley, Munro. Journal of the American Medical Association, 1904, vol. ii. p. 1183. Case VIII., adhesions; improved.

8. Bruns and Kredel. Archiv f. Psychiat., 1896, Band xxviii. p. 97, Case 1; Neurolog. Centralblatt, 1894, Band xiii., p. 281. Sarcoma; died.

9. Bruns and Lindemann. Archiv f. Psychiat., loc. cit., S. 133, Case 2. Neurolog. Centralblatt, loc. cit., S. 389. Sarcoma; died.

10. Caselli. Riforma Med., 1893, iv. p. 380. Osteoma; recovered.

11. Chipault, Dejerine, and Spiller. Comptes-rendus de la Soc. de biol., Paris, 1895, 10e Série, ii. p. 622. Sarcoma; died.

12. Crofts, Horsley. Clinical Journal, London, 1896–97, vol. ix. p. 183. Syringomyelia; improved.

13. Curtis. New York Medical Record, 1898, vol. i. p. 346. Secondary carcinoma; died.

14. Cushing. Annals of Surgery, 1904, vol. i. p. 934. Fibrosarcoma; recovered.

15. Davies, Colley. Transactions of the Clinical Society, London, 1892, vol. xxv. p. 163. Sarcoma; recovered.

16. Davis, George G. Journal of the American Medical Association, 1904, vol. i. p. 751. Sarcoma; no improvement.

17. Deaver, J. B., Lloyd, J. H. American Journal of the Medical Sciences, vol. lcvi. p. 564. Adhesions; died.

18. Elliot, Putnam, J. J. American Journal of the Medical Sciences, 1899, vol. cxviii. p. 385, Case 3; Journal of Nervous and Mental Disease, 1903, vol. xxx. p. 665, Case 1. Sarcoma; great improvement.

19. Elliot, Putnam, J. J. Journal of Nervous and Mental Disease, loc. cit., Case 2. Carcinoma; died.

20. Elliot. Ibid., loc. cit., Case 3. Fibrosarcoma; died.

21. Eskridge and Freeman. Philadelphia Medical Journal, 1898, vol. ii. p. 1236. Fibroma; recovered.

22. Eskridge and Rogers. Ibid., 1898, vol. i. p. 332. Tumor of vertebræ; died.

23. Faure, Hirtz, and Delamere. Bull. de la Soc. méd. des hôp., Paris, 1902, xix. p. 308. Endothelioma; died.

24. Fenger, Church, and Eisendrath. American Journal of the Medical Sciences, 1892, vol. ciii. p. 395, Case 6. Spindle-celled sarcoma; died.

25. Fripp, White, Hale. Transactions of the Clinical Society of London, 1900, vol. xxxiii. p. 140. Dermoid cyst; died.

26. Gerster. New York Medical Record, 1890, vol. ii. p. 131. Putnam and Warren. American Journal of the Medical Sciences, 1899, vol. cxviii. p. 388, Case 9. Sarcoma; died.

27. Gerster, Sachs. New York Medical Record, 1900, vol. i. p. 7, Case 2. Fibrosarcoma; improved.

28. Graff. Schultze, Mittheil. a. d. Grenzgeb. d. med. u. Chir., 1903, Band xii. p. 153, Case 7. Fibroma; much improved.

29. Graff. Ibid., loc. cit., Case 9. Fibromata; died.

30. Hahn. Deutsche Zeit. f. Chir., 1902, Band lxiii. p. 421, Case 1; Centralblatt f. Chir., 1902, Band xxix. p. 399, Case 1; Berliner klin. Woch., 1902, Band xxxix. p. 645, Casel. Echinococcus; died.

31. Hahn. Deutsche Zeit. f. Chir., loc. cit., Case 2; Centralblatt f. Woch., loc. cit., Case 2; Berliner klin. Woch., loc. cit., Case 2. Echinococcus; recovered.

32. Hahn. Berliner klin. Woch., loc. cit., Case 3. Osteoma; recovered.

33. Hahn. Deutsche Zeit. f. Chir., loc cit., Case 5; Berliner klin. Woch., loc. cit., Case 4. Syringomyelia; died.

34. Hartley, Fraenkl. Journal of Nervous and Mental Disease, 1903, vol. xxx. p. 101. Fibrosarcoma; died.

35. Horsley, Gowers. Transactions of the Medical Chirurgical Society of London, 1888, vol. lxxi. p. 377. Fibromyxoma; recovered.

36. Horsley. British Medical Journal, 1890, vol. ii. p. 1289, Table V. Not stated; died.

37. Horsley. Clinical Journal of London, 1896–97, vol. ix. p. 182. Echinococcus; recovered.

38. Horsley. Ibid., loc. cit., p. 183. Syringomyelia; improved.

39. Ignatoff, Vayenno. Medical Journal of St. Petersburg, I. Section., vol. clxxxvii. pp. 30–32; quoted by Putnam and Warren. American Journal of the Medical Sciences, 1899, vol. cxviii. p. 388, Case 13. Chondrosarcoma; improved.

40. Israel, J. Deutsche med. Woch., 1902, Band xxviii., Ver.-Beil. 369; 1903, Band xxix., Ver.-Beil. 110. Chondromyxosarcoma; much improved.

41. Krause, Sänger, A. Münch. med. Woch., 1894, Band xli. p. 431; Berliner klin. Woch., 1901, Band xxxviii. p. 583, Case 3. Sarcoma; died.

42. Krause, Selberg. Deutsche med. Woch., 1902, Band xxviii., Ver.-Beil., 368, Case 2. Remak. Berliner klin. Woch., 1902, Band xxxix. p. 646. Angiosarcoma; died.

43. Krause. Berliner klin. Woch., 1901, Band xxxviii. p. 541, Case 1. Psammoma; recovered.

44. Kümmel. Archiv f. klin. Chir., 1895, Band l. p. 452. Sarcoma; improved.

45. Lennander. Henschen, Upsala Läkaref. Forhandl. N. F., Band vi. p. 453, abstracted in Centralblatt f. Chir., 1902, Band xxx. p. 935. Schultze. Mittheil. a. d. Grenzgeb. d. Med. u. Chir., 1903, Band xii. p. 209. Fibrosarcoma; recovered.

46. Lloyd, S. American Medical and Surgical Bulletin, New York, 1896, vol. x. p. 659. Echinococcus; recovered.

47. Lloyd, S., Collins. Journal of Nervous and Mental Disease, 1903, vol. xxx. p. 100, Case 1. Not stated; much improved.

48. Macewen. Lancet, 1888, vol. ii. p. 254. Adhesions; recovered.

49. Macewen. Ibid., loc. cit., Case 2. Adhesions; recovered.

50. Macewen. Ibid., loc. cit., Case 3. Adhesions; recovered.

51. Macewen. Ibid., loc. cit., Case 4. Adhesions; died.

52. Macewen. Ibid., loc. cit., Case 5. Adhesions; died.

53. Martin, Spiller, and Musser. Transactions of the College of Physicians of Philadelphia, 1903, vol. xxv. p. 1. Cyst; recovered.

54. McCosh, Starr. Philadelphia Medical Journal, 1902, vol. i. p. 288; Journal of the American Medical Association, 1901, vol. ii. p. 569, Case 14. Fibroma; died.

55. McCosh, Starr. American Journal of the Medical Sciences, 1895, vol. cix. p. 613, Case 3; Journal of the American Medical Association, loc. cit., p. 626, Case 2 in Table II. Sarcoma; died.

56. McCosh. American Journal of the Medical Sciences, loc. cit., Case 5; Journal of the American Medical Association, loc. cit., Case 1 in Table II. Lipomata; died.

57. McCosh, Bailey. Journal of Nervous and Mental Diseases, 1903, vol. xxx. p. 99. Journal of the American Medical Association, loc. cit., p. 621, Case 11. Sarcoma or granulation tissue; recovered.

58. McCosh. Journal of the American Medical Association, loc cit., p. 621, Case 12. Sarcoma; improved.

59. McCosh. Journal of the American Medical Association, loc. cit., p. 621, Case 13. Sarcoma; died.

60. Mikulicz, Lichtheim. Deutsche. med. Woch., 1891, Band xvii. p. 1386. Psammoma; died.

61. Mikulicz. Ibid., loc. cit. Psammoma; marked improvement.

62. Munro. Journal of the American Medical Association, 1900, vol. i. p. 12, Case 18. Putnam and Warren. American Journal of the Medical Sciences, 1899, vol. cxviii. p. 388, Case 19. Sarcoma; died.

63. Munro. Journal of the American Medical Association, 1904, vol. ii. p. 1183, Case 10. Thomas, J. J. Transactions of the American Neurological Association, 1901, vol. xxvii. p. 182. Myeloma; much improved.

64. Munro. Journal of the American Medical Association, 1900, vol. i. p. 12, Case 17. Sarcoma; died.

65. Munro. Journal of the American Medical Association, 1900, vol. i. p. 12 Case 14. Cavities in cord; died.

66. Munro. Journal of the American Medical Association, 1900, vol. i. p. 12. Cyst; improved.

67. Park, Putnam and Krauss. American Journal of the Medical Sciences, 1903, vol. cxxv. p. 1. Sarcoma; much improved.

68. Pescarolo. Verhandl. d. X. Internat. med. Congr. (1890), Berlin, 1892, Band iv., Abth. ix., S. 9. Fibromyxosarcoma; not improved.

69. Quensel and Garten. Neurolog. Centralblatt, 1898, Band xvii. p. 482. Sarcoma; died.

70. Raymond. Journal de Neurol., Bruxelles, 1903, vol. viii. p. 203. Sarcoma; died.

71. Rehn, Laquer. Neurolog. Centralblatt, 1891, Band x. p. 193. Lymphangioma; recovered.

72. Schede, Schultze. Mittheil. a. d. Grenzgeb. d. Med. u. Chir., 1903, Band xii. p. 153, Case 2; Deutsche Zeit. f. Nervenh., 1900, Band xvi. p. 114, Case 1; Verhandl. d. Gesellsch. Deutscher Naturfor. u. Aerzte, 73, Versamml. zu Hamburg, 1901, Band ii. p. 100, Case 1. Fibrosarcoma; recovered.

73. Schede, Schultze. Mittheil. a. d. Grenzgeb., 1903, loc, cit., Case 3; Deutsche Zeit. f. Nervenh., loc. cit., Case 2; Verhandl. d. Gesellsch. deutsche Naturfor., u. s. w., loc. cit., Case 2. Fibromyxosarcoma; recovered.

74. Schede, Schultze. Mittheil. a. d. Grenzgeb., 1903, loc. cit., Case 5; Verhandl. d. Gesellsch. deutsche Naturfor., u. s. w., loc. cit., Case 3. Spindle-celled sarcoma; recovered.

75. Schede, Schultze. Mittheil. a. d. Grenzgeb., 1903, loc. cit., Case 6; Verhandl. d. Gesellsch. deutsche Naturfor., u. s. w., loc. cit., Case 4. Angiosarcoma myxomatodes; died.

76. Schede, Schultze. Mittheil. a. d. Grenzgeb., 1903, loc.cit., Case 8. Adhesions; died.

77. Sonnenburg. Verhandl. deutsche Gesellsch. Chir., XVIIIth Congress, Berlin, 1889, Band i. p. 86. Sarcoma; died.

78. Sonnenburg, Oppenheim. Berliner klin. Woch., 1902, Band xxxix. p. 21; Centralblatt f. Chir., 1901, Band xxviii p. 1250; Deutsche med. Woch., 1901, Band xxvii., Ver.-Beil. 242. Fibromyxoma; died.

79. Sonnenburg. Deutsche med. Woch., 1903, Band xxix., Ver.-Beil. 321. Oppenheim. Berliner klin. Woch., 1902, Band xxxix. p. 905. Fibroma; recovered.

80. Szekeres. Pester méd. chir. presse, 1894, p. 43; quoted by Putnam and Warren, American Journal of the Medical Sciences, 1899, vol. cxviii. p. 388, Case 32. Echinococcus; recovered.

81. Thompson, Ransom. British Medical Journal, 1894, vol. i. p. 395. Round-cell sarcoma; died.

82. Thorburn. British Medical Journal, 1895, vol. i. p. 1403. Adhesions; improved.

83. Thorburn. Brain, 1903, vol. xxvi. p. 120. Myxosarcoma; died.

84. Trendelenburg, Wilms. Beitr. z. klin. Chir., 1898, Band xxi. p. 151. Echinococcus; died.

85. Trendelenburg. Schultze, Mittheil. a. d. Grenzgeb. d. Med. u. Chir., 1903, Band xii. p. 153, Case 1. Pfeiffer. Deutsche Zeit. f. Nervenh., 1894, Band v. p. 62. Thickening; died.

86. Tytler and Williamson. British Medical Journal, 1903, vol. i. p. 301. Echinococcus; recovered.

87. Warren, Putnam, J. J. American Journal of the Medical Sciences, 1899, vol. cxviii. p. 377, Case 1; Journal of Nervous and Mental Diseases, 1903, vol. xxx. p. 665; note at end of Case 3. Fibroma; recovered.

88. Warren, Putnam. American Journal of the Medical Sciences, 1899, loc. cit., Case 2. Endothelioma; recovered.

89. Weber, Schmidt. Münch. med. Woch., 1904, Band li. p. 281; Deutsche Zeit. f. Nervenh., 1904, Band xxvii. p. 318. Cyst; recovered.

90. White, J. William. Annals of Surgery, 1889, vol. i. p. 424; Transactions of the American Surgical Association, 1891, vol. ix. p. 155. Dercum, Transactions of

the American Neurological Association, 1890, vol. xvi. p. 47. Adhesions; recovered.

91. Woolsey. New York Medical News, 1904, vol. ii. p. 625; Medical and Surgical Reports of the Presbyterian Hospital, New York, 1904, vol. vi. p. 64. Endothelioma; much improved.

92. Wyeth, Sachs. New York Medical Record, 1900, vol. i. p. 7, Case 1. Alveolar sarcoma; recovered.

# THREE CASES OF TUMOR OF THE SPINAL CORD OPERATED ON WITH GOOD RESULT.

By J. COLLINS WARREN, M.D.,
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The satisfactory result obtained by operation in each of these three cases makes a brief report of their symptoms and subsequent histories of some interest. In two extramedullary and easily enucleable tumors were found and the symptoms of pressure on the cord have been relieved. In the third case, in which the symptoms were known to be caused by an extensive intramedullary growth, a palliative operation gave complete relief to a most distressing condition and seemed to arrest a progressing paralysis.

Case I., operated on just seven years ago, and Case III., operated on seven and a half years ago, were reported by Dr. James J. Putnam and the writer in the *American Journal of the Medical Sciences* in October, 1899; but as the subsequent histories of both have been followed to the present time a further statement seems warrantable.

Case I.—The patient was a lady, aged fifty years at the time of operation. The first distinct symptom of her trouble had occurred about one year and three months previously, in the onset of severe attacks of pain, which gradually increased in frequency. This pain was most severe in the region of the lower left rib, the left side of the abdomen, and groin.

The wide extent of the pain is interesting, for it was not confined, as is sometimes the case, to a definite nerve area. The most striking symptom appeared about six months later, when the patient began to have difficulty in walking due to an inability to lift the left foot; and from that time on the pain increased in severity, until any movement of the body caused great distress and walking became impossible. At the time she was referred by

Dr. Putnam for operation she was in a helpless condition, unable to stand, and in constant pain. The deep reflexes were much exaggerated; there was impairment of sensibility in the area of the lumbar nerves, and the bladder was only partially under control. Operation was done in June, 1898, and by laminectomy the dura in the region of the eighth, ninth, and tenth dorsal vertebræ was exposed. The dura was incised at the level of the ninth dorsal vertebra, where a swelling was noticeable, and from beneath a fibroma was removed, which, lying in the meshes of the pia, had offered firm pressure on the left and posterior surface of the cord. The tumor was about the size and shape of an olive.

The recovery in this case has been practically complete, the history having been one of slow but progressive improvement. She is in fine health, and the only suggestion of her old trouble is in an occasional involuntary twitching and drawing up of the left foot, which is most noticeable when she is fatigued. Her gait is normal, but when fatigued she still assumes a stooping position. There is no undue excitability of the deep reflexes, motion is unrestricted, and sensibility is normal.

However, for less than a year has she been completely free from the pain which persisted so long after operation. That has been a striking feature of the convalescence. For the first few months, with the return of voluntary motion in the legs, there were associated most distressing cramps of the muscles.

Up to within two years she has been unable to walk more than very short distances without great fatigue and pain.

It seems in this case as if the restoration of function of the injured cord, though now practically complete, had been very slowly established, and in this respect it offers marked contrast to the following case:

Case II.—This patient, a married woman, aged twenty-seven years, entered the Massachusetts General Hospital on December 2, 1904, having been sent by Dr. Putnam for operation. Her history was briefly as follows:

For about two years she had suffered from pain in the left side over the lower ribs and upper abdomen, varying at times in intensity and location, and strongly suggestive of nerve-root irritation.

Six months before she had first noticed numbness of the toes of both feet, and for three months there had been increasing difficulty

in walking, due to a dragging of the left foot. For a few days there had been constant pain in the back and complete inability to walk. There was marked impairment of sensibility of both legs and on both sides of the abdomen.

The knee-jerks were lively and ankle clonus present. She was unable to move either leg, but the spastic condition was demonstrated on attempted manipulation. Four days later (December 6) laminectomy was performed and the cord at a level of the seventh, eighth, and ninth dorsal vertebræ exposed. The dura was incised with the escape of considerable cerebrospinal fluid, and at a level of the eighth vertebra a soft, dark, reddish tumor, about three-fourths of an inch long and the width of the canal, appeared. This mass was removed and the cord seen to be much compressed, pushed to the left and flattened.

Dr. W. F. Whitney reported the growth "to consist of a very cellular fibrous tissue with numerous small vessels, and concentric concretions infiltrated with lime salts, a psammoma."

The progress toward recovery in this case has been rapid. At the present time (six months after operation) the patient considers herself practically well. She walks about with an apparently normal gait and without support of any kind, and is able to attend to her household duties. Although the knee-jerks are still increased ankle clonus has disappeared and sensibility seems normal over the legs and abdomen. Movements of the legs are unrestricted.

A very striking feature of the convalescence has been an entire freedom from pain, so persistent before operation, which formed such a distressing symptom in the first case reported.

Case III.—This case is mentioned to show the beneficent result of laminectomy done as a palliative measure for the relief of agonizing pain in a man known to have an extensive intramedullary growth of the cord.

The patient is now forty-nine years old and for twenty-five years has shown symptoms of disease of the cord. Sixteen years ago the signs became those of a total transverse lesion, and since then he has been completely paralyzed below the waist as regards motion, sensation, and control of bladder and rectum. Fourteen years ago laminectomy was done by Dr. W. W. Keen, as the patient's general health was rapidly failing and there existed a possibility of finding a removable tumor. An enlarged bluish cord was

seen. The disease was plainly intramedullary. The man's health improved and for six years there was no marked change in his condition. During all this time he was subject to periodic attacks of pain in the back and shoulders, with chills and very high temperature, the attacks being probably associated with the spinal disease. In January, 1898, pain of great severity became persistent in the neck, shoulders, and arms. Nothing was successful in relieving the pain, which became intolerable. Signs of a progressing paralysis also manifested itself by numbness in both hands. At a consultation with Dr. Putnam it was decided to again perform laminectomy in the hope of relieving pressure in the canal. The cord above the old cicatrix was thickened and had the appearance of soft sarcomatous tissue. No cavities were found on incising the cord, and an examination of fragments removed showed it to be made up of small round cells, probably endotheliomatous in nature. Considerable cerebrospinal fluid was allowed to escape for two weeks, when the wound closed.

There was rapid improvement in general health, which has been excellent until the present time, now seven and one-half years after. The numbness of the fingers disappeared and during this time he has had no recurrence of the chills or pain.

Within the past two years he has taken up much of his former work as an architect.

The effect of the operation has been most gratifying, for nothing more than a relief of symptoms was expected.

## DISCUSSION ON THE PAPERS BY Drs. BURRELL, FOWLER, WILLARD, HARTE, AND WARREN.

Dr. John C. Munro, of Boston.

There are a number of points in connection with this symposium that interest me. Dr. Fowler spoke of section of the nerve roots for side-tracking the nerve current around the cord lesion. This is possible anatomically, as I did it a number of years ago on a cadaver, but I believe it is not as feasible as suture of the cord itself in the light of the result in Dr. Stewart and Dr. Harte's case. There is need of more work on suture of the cord itself.

Dr. Willard spoke of laminectomy in cases of Pott's disease, and I agree with his conclusion. I recall one striking case of this sort where the symptoms were due entirely to bony pressure. The patient, a young girl, had been totally paraplegic and anæsthetic for several years, but upon removing the laminæ and relieving bony pressure, sensation returned within forty-eight hours. Inside of a week there was considerable increase in motion. Cases like this we should not despair of, and results of this sort prove that we still know very little about the actual function of the cord. Here was a girl who, paralyzed for seven years, had been under good orthopedic treatment without any evidence of restoration of function. Upon removal of the laminæ and relief of bony pressure, function began to return within forty-eight hours.

The technique should be as simple as possible. Osteoplastic operations are dangerous and difficult. I say this from an experience based on over thirty operations of my own and probably as many more at which I have been present, and I have come to the conclusion that the simpler the technique the better. Very little shock attends such an operation.

Another thing; in a number of cases that I have had, cases of syringomyelia and of chronic fracture, I have found that which at one time was denied by pathologists, a definite, localized collection of clear fluid in the subarachnoid space which produces by its presence more or less complete paralysis. By opening this small sac of fluid the symptoms may be absolutely relieved. The intense pain which accompanies syringomyelia is relieved for a while as well. In a striking case of fracture with total paralysis lasting for several months, complete recovery dating from the time of the drainage followed evacuation of a localized collection of serum in the subarachnoid.

As to the cases of sarcoma which Dr. Harte spoke of as having

recovered, I am inclined to think that they may have been cases of myeloma, which in its appearance is very much like sarcoma. I have had two cases of complete paralysis in which the growth was extradural, but recovery from the paralysis was almost immediate and permanent upon removal of this soft growth. Of these two patients one died three years later of pneumonia, with myeloma in various flat bones. The second patient is still under observation for myeloma in various other bones, and comes to me occasionally to have the growths removed as they appear. The myelomatous growth in the spine, however, has not recurred, and the paralytic symptoms have practically disappeared. This type of tumor is one which has not been recognized very long by pathologists and it may explain some of the cases of recovery from sarcoma that Dr. Harte reports.

I think there is less danger from pachymeningitis than from subdural hemorrhage after laminectomy. I have had two cases of late paralysis following section of the nerve roots, where I made the mistake of performing the entire operation at one sitting. A small blood clot may form beneath the dura and produce a Brown-Séquard paralysis. With a clean operation I do not believe there is any risk of pachymeningitis.

I have not used the Horsley wax to arrest hemorrhage when cutting through the spine. I use a blunt periosteal elevator to crush the diploë edgewise. This stops bleeding at once, and I doubt if there is any necessity to use the Horsley wax except on rare occasions.

Dr. N. B. Carson, of St. Louis.

Like most surgeons, as my experience increases I am more and more in favor of immediate laminectomy in cases of traumatism of the spinal cord. I wish to cite three cases that have come under my observation which, I think, are of special interest in this connection.

The first case was the son of President Lincoln's Attorney-General. While swinging in a hammock one day with his head toward the incline, the rope broke, he turned a somersault, and rolled down a hill. There was almost complete paralysis following this accident. As he lived in the country some distance from a railroad, he was put into a wagon, brought to the railroad, and thence to St. Louis, where I saw him in consultation the second day after the receipt of the injury. A careful examination failed to elicit any evidence of deformity. The only thing noticeable was the undue mobility of the head. An operation was not undertaken, for the reason that we could not promise any decided or good result. The patient in due course of time died. A postmortem examination was made, and it was found that at the time of the accident the sharp bending of the spine had snapped the ligaments

between the seventh cervical and first dorsal, allowing the vertebræ to gape apart, the bodies impinging anteriorly. The seventh cervical slipped forward far enough to partially occlude the spinal foramen of the first dorsal. When the man was picked up and partial restoration of the line of the vertebræ was produced, the articular processes, which are vertical in this region, approximated back to back—a dislocation impossible of reduction except by reproducing almost the original bend of the spinal column. If a laminectomy had been done in this case, I am inclined to think the result might have been favorable, and if the patient should not have entirely recovered he certainly would have been relieved and his life saved.

The second case I was called to see in consultation at the City Hospital in St. Louis. In this city all accidents and injury cases come immediately under the supervision of the police, and are hauled to the City Hospital. While the treatment is the best it can be, under the political rule, it is not the best that can be afforded. The patient was neglected, and I saw him some time after the receipt of the injury. Paralysis was not complete at first, but gradually increased. I think it was two or three weeks after the receipt of the injury when I saw him, and advised operation, which was done, and it was found that the spinal cord had not been injured. There was a fracture with pressure, and if this operation had been done early and the pressure relieved, the chances are that the patient would have been relieved permanently. However, the operation, done as it was after degeneration in the spinal cord had taken place, resulted beneficially to the patient, although he did not completely recover.

The third case is one I reported some years ago at a meeting, held in New Orleans, when this subject was under discussion. This case shows the good results that may come from immediate action in this class of cases. The patient was a man who, in driving upon a load of hay and passing through the doorway, stooped and caught his spine, and was doubled upon himself. There was complete dislocation; the projection or tumor was marked, so that I could have put nearly three fingers under the projecting part. There was complete paralysis of all parts supplied by the nerves from this region. I saw the patient within an hour and a half after the receipt of the injury. I explained to him the dangers of what I proposed to do. He said that he would sooner die than live in his present condition. I suspended him and reduced the dislocation. Very little shock followed the procedure, but all preparations had been made for it. He was immediately taken down from the suspended position, placed upon a plane, and a plaster-of-Paris jacket applied. He went to the country in less than three months after the operation, and is now in perfect health.

Dr. Maurice H. Richardson, of Boston.

I should like to say a word as to the indications for operation in lesions of the spinal cord. Indications must depend upon prognosis. I was at one time convinced, from what I had seen and done, that in traumatism the prognosis was practically hopeless; that the results after non-operative treatment were no worse than those after operative. After listening to the papers of this morning, however, I cannot but feel encouragement. We must remember, as Dr. Munro has said, that from a few operations upon the cord (and Dr. Munro's experience is much larger than mine in this regard, as he has himself operated on more than thirty cases besides taking part in twenty or thirty other operations), we can learn but little about the real prognosis. In Boston there has been a certain amount of reaction against the rule to explore the spinal canal in all cases of broken back. The broken backs operated upon at the Massachusetts General Hospital almost invariably did badly. In these cases a lingering death followed months of great suffering. A reaction against universal operation in traumatisms of the cord resulted, as I say. But then we were forced to admit that the results without operation were just as bad, or even worse. The fact is that we cannot—from thirty, forty, or even a hundred cases—deduce the prognosis. The reasonable course to follow, therefore, when we do not know just what has taken place in the cord, is, it seems to me, to explore the spinal canal and find out, especially when, as Dr. Munro has pointed out, the danger is no greater than that of exploratory laparotomy. Not that I would for a moment admit that there is no danger in opening the abdomen, for I know that there is; but that danger is slight.

With a series of splendid cases such as Dr. Warren has given us, the indications for operation in suspected tumors of the spinal cord and canal are unmistakable. Unless the case is clearly a hopeless one—and the demonstration of hopelessness, excluding cases of evident cancerous metastases, cannot positively be made without exploration—the duty of the surgeon is to explore and find out the exact state of things. Since the prognosis without operation is almost invariably hopeless; since human fallibility is what it is; and since cases like those here reported are by no means infrequent—the surgeon is indeed assuming a heavy load of responsibility when he advises against almost the only chance for cure. We cannot expect always to have the remarkable results just reported; but we cannot help feeling great encouragement. My own have been discouraging, and yet I cannot regret making at least a faithful effort.

After listening to the papers on this subject, we shall undertake these cases with renewed hope. Indeed, the great advantage of candid

discussions in an association of men whose work we admire and whose opinions we respect is that we carry home to the solution of problems that wearied and puzzled us a freshened enthusiasm and renewed hope.

Dr. Dudley P. Allen, of Cleveland.

While I share the feeling of those who have expressed themselves to-day as having an increasing confidence in the operation of laminectomy in cases of traumatism of the spine, it must be remembered that there are some cases of traumatism of the spine which recover without operation. I have had a considerable experience in cases of the kind, and it has been my good fortune to see a number of cases having paralysis of both lower extremities and of the entire trunk, yet these patients have made an almost absolute recovery without operation. I have seen many other cases with symptoms less severe recover, and these recoveries have been secured by a method that has not been mentioned. It consists of placing these patients in bed on a hard mattress on a flat surface, raising the head of the bed twenty degrees, and using the Sayre suspension apparatus with pulley over the head of the bed and with heavy weight, so that this weight extends the spine and counterbalances the tendency of the patient to slip down to the foot of the bed.

In certain cases in which the employment of mechanical treatment is of doubtful propriety, there can be no question but what we had better operate. However, in a number of cases that would not bear operation, or upon whom it was impossible under existing conditions to perform any such operation, it has been my experience that great benefit, and even a cure, have been secured by placing these patients in bed in the manner mentioned, with extension attached to the head, so that the spine has been held in extension. In these no Bradford frame has been used.

Dr. A. J. Ochsner, of Chicago.

The history in these cases is frequently so indefinite that it is of little value, but whenever it is definite, showing that paralysis occurred at once after the injury, this indicates that there can be present but one of three conditions—severe concussion, pressure, or destruction of the cord itself. The pressure may be due to a dislocation or fracture with displacement. If that can be relieved, the paralysis will soon disappear. If we can then provide against recurrence of the pressure by the method which Dr. Allen has described, or by means of the application of a plaster cast described by Dr. Burrell, we have accomplished everything that can be done. If this cannot be done, then it seems as though immediate operation is indicated, because without it the patient is doomed. If paralysis is simply due to pressure, then the patient is almost certain to recover after it has been relieved, unless this is post-

poned until the pressure has resulted in degeneration. In cases in which the history is definite in the other direction, and we know that paralysis has occurred slowly after the injury, it is doubtful whether an operation should be performed. I had several cases of this class that have recovered with a treatment similar to that which Dr. Allen has described.

I have operated on a number of cases late, and in none of them with much benefit.

There is one point I wish to make in connection with Dr. Willard's paper. I desire to speak of the very great benefit that many of my patients have experienced after the use of what is known as the Goldthwaite frame in the application of plaster of Paris body casts in tuberculosis of the spine. The principle is the same as that illustrated in the paper of Dr. Willard. It is very much better than the use of the sling, although apparently, simply looking at it theoretically, the result should be the same. But the result is entirely different, because in the Goldthwaite frame we have two malleable steel bars which can be accurately adjusted so as to exert the amount of pressure we want, and by placing a perforated felt pad over the projection we can protect the spine absolutely, so that the benefit is vastly greater than from the use of the Sayre suspension apparatus, or from the use of anything else that I have employed. The principle is the same as that employed here, with the exception that the bars provide for a continuous support. However, the support here is almost continuous, so that I should imagine this method would probably be as good.

Dr. George Tully Vaughan, of Washington, D. C.

As this is such a big subject, I can only hope to make a few remarks on a portion of it, and I shall confine what I have to say to injuries of the spine.

There are certainly some cases in which it is best not to operate in fractures, dislocations, or injuries of the spine. It is very difficult to decide *when* and *when not* to operate. I have had an experience which has taught me that it is not proper to operate in all cases, and I will cite a case in point. A man was struck in the back with a baseball bat; he had complete paralysis of the lower extremities following this injury, which lasted six to twelve hours, and I hesitated whether to operate or not. He went to sleep that night and the next morning the paralysis had completely disappeared. If I had operated in that case within two or three hours, which we think is usually the best time to operate, the operation undoubtedly would have received credit for the cure. On the other hand, there are cases in which operation is the proper thing. In every case, where there is pressure on the cord, from blood or bone, if we can exclude simple concussion, such as I believe my case to have

been, the proper treatment is to do laminectomy. I would rather trust to that operation than to attempt to reduce a dislocation of the spine by any mechanical means, as I believe the risk is less. However, I may be mistaken about that.

I have had an experience of ten laminectomies, four of them for injuries in the cervical region, the others in the dorsal and lumbar regions. Of the four fractures in the cervical region, three died of the traumatism; and four or five cases which I did not treat by operation died also—all dying within a week usually. The last case I had was operated on about three weeks ago; the patient is still living, or was when I left Washington. He had a fracture of the sixth cervical vertebra, with complete paralysis from the clavicle down, presenting the usual picture of paralysis following a broken neck.

Of the six cases in which the injury involved the lower part of the spine, two of them were below the spinal cord, affecting the cauda equina. These last two patients I believe will get well, as neither the bladder nor the bowels were permanently affected. They were paralyzed for a week; then the patients got control over them, and although the legs were paralyzed for quite a long time (I think it was a month before there were any signs of motion or the return of sensation), they are both recovering.

There were two cases of gunshot wound of the spine in which the cord was not touched by the bullet, but in one the ball passed through the lumbar vertebra in front of the cord, producing paralysis of motion, but not of sensation. The anterior roots alone were affected, and not the posterior. Unfortunately, the patient died two days after operation, I do not know why.

Of this list of ten cases, I can consider only three of them as cured; that is, they did not die from operation or directly from the injury. Two were injuries to the cauda equina, already mentioned, and are still living. One lived ten months, and died of acute intestinal obstruction; but his paralysis had not improved. In the mean time he had trouble with one kidney, with obstruction of the ureter, was operated upon, recovered from the operation, and then died, as I have said, finally from obstruction of the bowels.

According to my observation, I believe cases of fracture of the cervical vertebræ, with complete paralysis, are uniformly fatal. I think Dr. Courtney, of Boston, collected some fifty cases which occurred at the City Hospital in Boston, all of whom died within a month, some of whom were operated, and some not.

Dr. Munro. Since Dr. Vaughan has referred to the cases collected by Dr. Courtney, I wish to say that since Dr. Courtney's paper was

written there have been three recoveries following operation on cervical fracture at the City Hospital in Boston. One other patient recovered only partially without operation. Dr. Mixter has likewise had one or two recoveries in cases of cervical fracture. These cases were considered at the time as total transverse lesions of the cord.

Dr. Harte. I was very much interested in the case reported by Dr. Fowler, because it so closely resembles the one I had the pleasure of reporting in connection with Dr. Stewart, at the meeting held three years ago in Albany. I know that many of the Fellows of the Association were interested in that case; for it seems to open up a new field in regard to the regeneration of the cord. There appears to be an element of doubt on the part of some of the neurologists with regard to the possibility of the lesion. Provision has been made that in due time the specimen may be procured and tell its own story.

Dr. Fowler (closing the discussion on his part). I wish to say, in connection with the statement made by Dr. Munro, that suture of the adjacent spinal nerves has been done upon the cadaver, that my suggestion was made from a physiological and not from an anatomical standpoint. Unless I am very much mistaken, this has not been done. It is in this direction that some experimental investigation might profitably be made.

In the class of injuries under discussion (if I may be allowed to discuss the other papers in connection with the closing remarks of my own case), I wish to say that the history of the injury assists largely in the matter of deciding whether to operate at once or not. There is no question that if the injury results from diving in an insufficient depth of water, and the patient is immediately paralyzed, a serious injury of the cervical vertebræ has occurred, and the sooner efforts are made to remove the impinging fragments of bone, the better for the patient. In such a case an immediate operation is imperatively demanded. On the other hand a blow on the back by a baseball bat may result in a contusion of the cord; in all probability the patient may recover as quickly as did Dr. Vaughan's patient. If he recovers slowly extradural or intradural hemorrhage is probably present; in this class of cases a longer wait is justifiable. In those cases in which sandbanks fall on laboring men and fracture the lumbar and dorsal vertebræ there is no question as to not only the desirability, but the positive duty of the surgeon, of interfering operatively at once. Instances occasionally occur in which fracture of the vertebræ is limited; hemorrhage into the cord occurs, and comparatively rapid recovery follows the removal of a fragment. In a case now under

my care a fracture of the sixth cervical vertebra occurred. This was confined to the lamina of one side, in which crepitation was felt, but the contour was not disturbed. An exploratory operation revealed the lamina broken on one side, which was restored to its original position. I removed the broken portion, which was slightly pointed, and while there was some hæmatoma present, with more or less fluid blood in the subdural space and about the cord (the dura being wounded), the patient is now in the hospital making a satisfactory recovery, so far as I am able to judge, from the gradual clearing up of the symptoms of paralysis.

Shock is not usually very great in this class of cases in my experience; and so far as the condition of the patient himself is concerned, the contraindications of immediate operation are not great, from the standpoint of shock.

In reply to the suggestion of Dr. Harte, the cord was injured in my own case as it was injured in Dr. Harte's case. Drs. Frazier and Spiller have not been able to clear up this regeneration of the cord, and only experimental evidence can clear up the matter. I have kept the patient in the hospital, and shall continue to hold him under observation in the hope that when he dies we may be able to clear up the question as to regeneration of the cord.

Dr. Willard (closing the discussion on his part). In the late operation of laminectomy for paraplegia we undoubtedly secure improvement by allowing the cord to angulate more evenly, since relief from posterior pressure permits expansion of the cord. After two years of thorough fixation treatment, laminectomy is certainly justifiable if the tuberculous deposit has not been sufficiently absorbed to restore motion.

In acute traumatisms of the cord, where crepitus and deformity are absent, but where paralysis exists, intraspinal hemorrhage is often present. In these cases improvement may take place after a time, with almost an entire cure. I have seen a number of cases in the hospital where at first the symptoms were severe, although coming on a little later than in fracture, yet recovering under proper treatment. When, however, positive evidences of fracture of the lamina exist, then I am sure immediate or at least early interference should be undertaken.

With reference to the question of treatment of tuberculous caries paraplegia, I did not have time in the limited space accorded the discussion to go more thoroughly into mechanical treatment, but I always employ, during the year or two years of waiting for the tuberculous deposit to become absorbed, either head extension with rigid fixation or the Bradford frame to give hyperextension and throw the weight of the body upon the posterior arches, or the Goldthwaite frame, as referred to by Dr. Ochsner.

# SPINA BIFIDA, WITH AN ANALYSIS OF THREE HUNDRED AND EIGHTY-FIVE CASES TREATED BY EXCISION.

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Since it is impossible for one person to have large enough experience in this comparatively rare affliction to enable him to speak authoritatively upon the subject, I thought it might be helpful to collect as many cases from the literature as possible. To that end I offer to-day an analysis of all the cases treated by operation and on file in the *Index Catalogue* of the Library of the Surgeon-General's Office in Washington, both printed and in supplementary cards. These reports are from every civilized people on the globe. They begin with a case reported by an American surgeon, H. H. Sherwood, in 1813, and end with cases reported in 1905. There are sixty-seven articles with report of cases by injection of iodine, but this treatment has been practically abandoned as dangerous and unsurgical. There are 190 articles, in which 378 cases treated by excision are reported. Although a few cases are reported in which the tumor appeared after birth, it is evident that the bony defect was congenital and from causes unknown. In this series the sex of the patient was mentioned but 200 times, and of these there were 98 males and 102 females.

The diagnosis presents no difficulty except in certain cases of spina bifida occulta. I recently examined a woman, aged twenty-four years, who walked with a gait resembling that of a patient with a very mild form of spastic paralysis. She was very nervous and hysterical and subject to severe headache and backache. Upon

examining her spine my attention was attracted by a heavy growth of black hair over the lumbar region, which is quite characteristic of spina bifida occulta. There was no tumor, but by careful palpation a defect could be detected in the spine which established the diagnosis.

A few of these cases have been operated upon on account of severe pain. Fibrous bands have been found pressing upon the cord, and their removal has resulted in relief from pain. Theoretically only meningoceles and select cases of meningomyeloceles should be operated upon, but practically it is often impossible to tell the variety before operation. Paralysis and atrophy of lower extremities and lack of control of the sphincters indicate the graver forms.

Analysis of the cases here collected gives us a different result concerning the relative frequency in different localities from that which has obtained in the literature heretofore: 23 per cent. were sacral, 34 per cent. lumbar, 29 per cent. lumbosacral, 4½ per cent. dorsal, 9.5 per cent. cervical, and 2 cases were occipital.

The prognosis in spina bifida without operation, except in cases where the tumor is very small and well covered, is hopeless in the extreme. A very large percentage of them die early from leakage of cerebrospinal fluid and meningitis. The prognosis with operation is not so good as we could wish. The prognosis, both as to mortality and to end results, naturally varies with the character of the tumor, the age of the patient, and the operation. In large-sized tumors with thin septic coverings and complicating hydrocephalus, in all cases of myelocele and in most cases of meningomyelocele with paralytic complications the danger of death following operation is great and the end results are unsatisfactory.

In the cases reported in this paper there were 23 per cent. of complications quite evenly divided between paralysis, clubfoot, and hydrocephalus, and in many cases all of these complications were present. In 1 single case the clubfoot was reported improved, in 1 case incontinence was reported cured, and in 2 cases improved, but in all other cases there was absolutely no improvement. To counterbalance this 1 case cured and 3 improved

several cases of paresis and incontinence developed following the operation, presumably due to injury to the nerves or cord.

The age at which the operation was performed showed the most decided bearing upon the mortality. Of those operated upon within the first few months of life the mortality was over 35 per cent., while in those operated upon when five or more years old, the mortality was but 4.7 per cent. Of course this difference can be largely accounted for from the fact that the patients living five years or more were not bad cases and were good subjects for operation, but it raises the question whether it is really worth while to operate upon these patients early.

In 1895 Hanson[1] reported 150 cases from the literature treated by excision during the aseptic period with 27 per cent. mortality.

In the cases here reported the average mortality was 27 per cent. In those operated before 1885 the mortality was 30 per cent., and in those operated during and after 1885 the mortality was but 24 per cent. There was a reported mortality of 7 per cent. within three months after operation, which would make the real average mortality about 35 per cent. If all cases had been followed and reported the probability is that the mortality at the time of and a few months subsequent to operation would be fully 50 per cent.

Bayer,[2] whose writings upon this subject occupy a prominent place in the literature in 1892, reported 14 cases and claimed that surgical interference was admissible even in cases where the filum terminale of the cord and nerves are attached to the sac wall, because they can be successfully dissected off and returned to the canal, and in paralytic cases because they are otherwise doomed to die of meningitis, but in 1897[3] he reports 3 additional cases and concludes that 59 per cent. of patients operated upon for spina bifida will die sooner or later, and he will operate in future under the following conditions only: 1. When there is no decided hydrocephalus. 2. When there is no paralysis. 3. When clinically no complications are to be expected in the sac.

In 1893 Hildebrand[4] reports 13 cases operated on in König's clinic, and concludes that most myeloceles and meningomyelo-

celes and cases complicated by irreparable deformities and severe paralysis should not be operated upon.

Sachtlaben in 1903[5] reports 30 cases of spina bifida occurring in Mikulicz's clinic, of which 18 were operated upon. Of these 18 6 died and 12 were locally cured, but only 5 were completely cured. Of the 12 cured locally, 6 died between three and one-half months and one year after operation. These were the cases complicated with paralysis or hydrocephalus. The 5 permanently cured were simple meningoceles. Final results were satisfactory in only 38.9 per cent. of the operated cases.

Broca[6] in 1895 reports several cases, and concludes that operation is not advisable.

Mayo Robson[7] in 1895 reports 20 operations with a mortality of 30 per cent. He advised operation in all cases except where the tumor is so small that operation is evidently not needed, and where there is a large fissure, marked hydrocephalus, and paralysis.

My personal experience is limited to 7 operations with 1 death; 6 of my patients were select cases, in which the coverings were intact, complications absent or very mild, and the child old enough and well enough to give promise of future usefulness. The 1 death was in a patient four months old with a very large tumor with septic covering. It did well for a few days and then died of meningitis.

The causes of death following operation most frequently mentioned are shock, convulsions, meningitis, hydrocephalus, and late infections. The accidents during operation were very few. Hemorrhage is not mentioned. Early operators were very careful to avoid a sudden outlet of cerebrospinal fluid, but later operators have frequently made free incision into the sac with no noticeable bad effect. In 1 of my cases the patient was lying prone with the hips elevated, when a large quantity of liquid escaped suddenly without perceptible effect upon either pulse or respiration. As a rule the nerve filaments attached to the sac have been dissected off and returned to the canal, or when this was impossible the meninges were returned with the nerves. In numerous instances

the nerves were removed with no noticeable effect. In 1 of Cockburn's cases, reported in the *American Journal of the Medical Sciences*, three-fourths of an inch of the cauda equina was cut off because it could not be returned without bad results. In this case there was general incontinence before the operation, but after seven years, the reporter informs me, the only defect is a partial paralysis of the sphincter ani, which is noticeable only when the boy is suffering from diarrhœa. Death during operation occurred very seldom. The anæsthetic most frequently mentioned was chloroform, but the reports on this point were very meagre.

The mechanical principles of the operation have been the same from the first, but changes in the operative technique have been made by the adoption of absorbable buried sutures and modern aseptic methods. A number of surgeons have attempted to fill the bony defect in the canal by the implantation of bone from animals, but without success.

Bobroff[8] filled the gap with bone successfully by taking a bony flap from the iliac crest, preserving its circulation through its attachment to the soft parts.

Zenenko[9] recommends the filling of the bony gap by taking bone from the remains of the sacral arches and the tuberosities of the posterior surface of the sacrum. The bone-flap method has been quite commonly employed by Russian surgeons, but the concensus of opinion is expressed by Bayer, who says that the muscles and fascia are sufficient. Mikulicz obtained his lasting results without bony or muscular flaps. The bone-flap method adds materially to the danger of the operation and experience teaches that it is not necessary, because there is very little tendency to relapse. Very few relapses are reported following any of the various methods.

The only indications to be met in an operation for spina bifida are the removal of the sac and the closure of the cleft, and the simplest technique is the best.

The patient should be placed prone with the hips elevated. When there is an ulcerated septic surface it should be made sterile by repeated washings, followed by 95 per cent. carbolic acid and alcohol. When possible redundant skin flaps should be made, so

that they can be approximated without tension. The sac is next opened freely with knife or scissors. When the tumor is a simple meningocele it is dissected free down to the cleft with a knife and for a short distance within with a blunt instrument. It is then cut away, leaving enough to make ample meningeal flaps. When nerve filaments are present it is customary to dissect them loose and return them, which is usually easy to accomplish. When, as sometimes happens, it is difficult to dissect the nerves from the meninges, it is the usual custom to return them together with the meninges within the cleft. In many cases reported the nerves could not be returned and were removed without harm. The probability is that much time has been wasted in preserving functionless nerve filaments. When they end in the sac it is difficult to understand how they can perform any function. The meningeal opening is next closed with fine chromic catgut. The sac having been removed and the meningeal opening closed, flaps of muscle and fascia should be dissected from either side and brought together without tension by many chromic gut sutures. When the cleft is small very little if any dissecting is required, but when larger it may be necessary to make a longitudinal incision on either side at some distance from the cleft, so that the flaps can be slid toward the centre. Finally the integumentary flaps are united with silk and an ample surgical dressing applied. In young children the wound should be protected from the urine and feces by a collodion dressing.

A careful study of these reported cases illustrating the experience of so many surgeons seems to justify the following conclusions:

1. Operation upon children of very tender age is scarcely worth while, because it is accompanied by so large a mortality rate, and because it does not stop the progress of progressing cases.

2. Patients five or more years old can be operated upon safely.

3. Patients with large or rapidly growing tumors, with hydrocephalus and with paralysis or deformities of the extremities, are not cured.

Finally, all we can hope to accomplish by operation for spina

bifida is to relieve the patient of an unsightly and annoying tumor after he has survived the dangers of the affliction *per se*.

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## DISCUSSION.

Dr. Roswell Park, of Buffalo.

I have lately had a series of ten cases of spina bifida, of which, however, I prefer to speak of seven, because only in those seven cases did I carry out the principles which Dr. Moore described in his paper. I have had better success with the implantation of foreign material as a protective than is reported in the paper which he has read. I have used ivory, celluloid, and silver-foil, and only once have I had to take out any of the material which I put in. Of these seven cases six recovered, and my results have been so satisfactory that I would like simply to add my cases to those which the essayist has reported.

In regard to the technique, it is my custom in these cases, as it is in the other spinal cases, when the dura is exposed, to inject into the dural cavity a small dose of cocaine solution, not so much for the purpose of anæsthesia, as simply for quieting down reflex activity and avoiding any unpleasant effects from that source.

Dr. Emmet Rixford, of San Francisco.

In connection with Dr. Moore's paper I wish to report two operations on cases of spina bifida which comprise the extent of my experience. Both operations were done on infants. In one case the child being two weeks old, the tumor was perhaps the size of a turkey's egg; was sloughing superficially. Death occurred from meningitis two weeks after the operation.

The second case was brought to me some fifty miles from the country. The spina bifida was large and had ruptured at birth. I operated at the end of twenty-four hours. The case was one of meningomyelocele, with fluid in the central canal; nerve filaments were spread about the sides of the sac. These nerve filaments were dissected away as well as possible, many of them being cut. A very large, redundant sac was trimmed away and the wound closed with transverse suture line. The child was sent home the next morning, the father being told that the child probably could not live. A month later I heard that the child had not only survived, but was thriving, except for the fact that it was developing a hydrocephalus. It is now some seven or eight months since the operation was performed, and at the last report from the family physician two weeks ago the hydrocephalus was rapidly lessening. It probably will not disappear permanently.

Dr. W. H. Carmalt, of New Haven.

I have had one case of spina bifida which presented some peculiar anatomical conditions that are worth reporting. The patient, a child, a girl aged two and a half years, was brought to my clinic with a spina bifida involving the spine in the lumbosacral region. The tumor was about the size of half an orange, but projecting from that tumor again was another one about as long as my finger, and about this shape (indicating), the end of which was exposed with red surface looking very much like an exposed glans penis. From this surface there continually exuded a clear fluid, falling away in drops every few minutes. This fluid collected and examined was reported, as near as could be determined, to have the chemical constituents of cerebrospinal fluid. I operated, making a longitudinal incision, dissecting out that portion which I supposed belonged to the inner membranes, dissecting out the nerve, and returned the cord into the canal. The tumor itself was fluctuating, and consisted almost entirely of fluid, which escaped without any untoward symptoms at the time of the operation. After returning the cord into the canal I closed the opening in the bony canal by fracturing the edges of the lamina and bringing them together, fastening them with silver wire, and succeeded in making a fairly firm closure. The opening consisted of the two lower dorsal and a segment of the first sacral vertebræ. I then closed the wound in the external skin over it. There was no change in the condition after operation; the paraplegia continued. I was careful to wash off the exposed secreting surface with boric acid solution and to take all necessary precautions against active sepsis before returning the cord. There was no infection. The wound healed kindly. The child remained in the hospital some four months, with no marked changes, and was then discharged. Some three months later she was brought back to the hospital with a large slough over the sacrum and buttocks which had been brought about on account of being exposed to septic conditions. The surroundings were of the most disagreeable character, and infection occurred from scraping the buttocks over the floor, as the child crawled about in its paralyzed condition, dragging itself by its hands and arms. This was not the result of the operation, as from that the child recovered entirely. It finally died of septic pleuritis.

Dr. J. Collins Warren, of Boston.

I have operated on a number of cases, but recall the end results of only three. These operations were done on young infants, one in the dorsal region and two in the sacral region, and I was able to follow the cases through different periods of time. In two cases there was hydrocephalus following. In the other there was apparent recovery.

My method of operating has been to dissect around the sac without opening it, if possible, generally having opened it before the dissection was completed, and to put a ligature around the pedicle of the sac. I have noticed always, in the cases I have operated on, an escape of cerebrospinal fluid a few days after operation, and I have therefore felt inclined to use drainage in these wounds.

The question of sepsis in young children has to be considered, particularly in regard to wounds near the sacrum, and I try by position to prevent infection from feces or urine, putting the child in such a position that the wound will be at the highest possible point by up-building with pillows. This position can be maintained satisfactorily if a special nurse is employed.

Dr. De Forest Willard, of Philadelphia.

I agree with Dr. Moore's conclusions with the exception of the one in which he stated he did not think operation in young children had any special effect in arresting the advance of progressive cases of spina bifida.

Osteoplastic flaps are better than the use of any foreign material. In young children these flaps can be easily obtained from the sacrum and from the crest of the ilium. These flaps may be turned in without sacrificing their vitality, and by leaving their bases attached we have a strong support.

Hydrocephalus, when it develops, often proceeds to the limit almost of expansibility of the skull, and although it may be stationary for a time, it will steadily progress. It is one of the most unfortunate of the end results in these cases.

Dr. George R. Fowler, of Brooklyn.

I take it, according to the suggestion of Dr. Willard, that there are certain underlying conditions in the etiology of hydrocephalus and of spina bifida that are unfavorable to cure. One of the most discouraging aspects of the whole question is whether even with successful closure of the defect in the bony canal there will not subsequently develop conditions which, without the original presence of this defect, would have either destroyed the child or left it a ready victim to the effects of hydrocephalus.

The advantages of early operation in cases of spina bifida relate almost entirely to those to be derived from the absence of a septic condition. Occasionally there occurs early abrasion of the skin and ulceration, and the consequence is that septic conditions develop quite early. In one case of my own it was present upon the seventh day, and I

operated at once. I resorted to the usual excision method in this case. I employ the osteoplastic method, turning in the rudimentary arches of the vertebræ. The defect was in the lumbosacral region; the immediate result was good. The child died later on and unexpectedly with a complicating pneumonia.

In a second case the patient was three days old when operation was undertaken. I did the operation at the solicitation of the physician in the case, and because it seemed to me that the defect in the skin, covering the spina bifida itself, threatened very early ulceration. Although no symptoms of hydrocephalus were present, the patient died on the fifteenth day after operation, when the wound had entirely healed. The operation in the first case was done by the osteoplastic method. The patient died from well-pronounced intracranial pressure.

There is one suggestion in these cases, in which septic conditions are already present, which I have followed out, and that is to paint the surface with tincture of iodine before operation. In view of the well-known antiseptic quality of iodine, this application of iodine is instrumental in preventing the occurrence of septic conditions.

The question of suturing the opening in the membrane is still a somewhat unsettled one. I think it is a waste of time. In my own cases I have entirely disregarded this, depending on bringing together the osteoplastic flap or the portions employed in the osteoplastic replacement. To maintain the osteoplastic replacement, I have employed transversely placed sutures of silver, placed in the manner that Halsted employs in operations for hernia—the mattress suture. I remove it on the fourth or fifth day.

In the after-treatment, which was mentioned by Dr. Warren, elevating the hips and placing the patient in a lateral position have served in the cases I have operated on in protecting the line of union from soiling by the movements of the bowels and by the urine.

Dr. Moore. I am very much obliged to the Fellows for the interest they have taken in my paper. I thought a statistical study embracing the experience of others rather than that of my own might prove of interest to you.

Dr. Park mentioned the use of ivory, silver, etc. These materials have been used in these cases quite frequently, and usually with success. I intended to have mentioned that in my paper, put neglected to do so. I am glad, however, that Dr. Park has brought it out. The reason I did not dwell upon it was that they are not necessary, as muscle and skin flaps are sufficient and will guard against recurrence.

Dr. Rixford's case of spina bifida, in which rupture occurred, is not an uncommon experience, and such cases have been operated on many

times, and the surprising part is that they have recovered immediately from the operation, but have died all later from hydrocephalus, because those are the cases which have a tendency to hydrocephalus. Why hydrocephalus develops, I do not know.

Dr. Warren spoke of ligating the sac. That is all right when the neck of the sac is small, because there are no nerve filaments in these cases. In my cases I twisted the sac and tied it.

As to drainage, I am skeptical about the advisability of it. One of the speakers said there was no more danger of infection in these cases of spina bifida than from opening the peritoneum. In the peritoneum one can operate without imminent danger, and drain, but I doubt if that is true in spina bifida. These patients are very young, and if you institute drainage you may have great difficulty in preventing the wound from becoming contaminated by urine and feces.

Dr. Willard referred to osteoplastic flaps. I stated in my paper that the consensus of opinion is that they are really not necessary because very few relapses are reported in all these cases. Some surgeons follow their cases up for months and years. I agree thoroughly with what has been said, that the use of osteoplastic flaps will not prevent hydrocephalus. There is nothing known that will prevent the progress of hydrocephalus.

Dr. Fowler spoke of the advantage of early operation and suggested that threatened rupture is an indication for it. I have studied that point very carefully and have found that in those cases in which hydrocephalus develops one might just as well let rupture occur and allow the patient to die rather than bring surgery into disrepute.

Dr. Park's suggestion in regard to the use of cocaine is a very happy one.

As to washing the surface with a 95 per cent. solution of carbolic acid, and very soon thereafter using pure alcohol, I have used that where there was a sloughing septic surface to begin with.

# REVIEW OF NINE CASES OF EXOPHTHALMIC GOITRE.

By THOMAS W. HUNTINGTON, M.D.,
SAN FRANCISCO.

During the past three years I have treated surgically 9 patients suffering from exophthalmic goitre. In each instance partial ablation of one or both lobes of the thyroid was done and 1 patient was subjected to three operations successively, as will appear later: 7 were females; 2 were males.

The ages ranged from twenty-eight to fifty-six years, the average age being forty-two years. In 5 patients the development of symptoms of Graves' disease was associated with pre-existing enlargement of the thyroid; 2 of these were cystic colloid. In 4 the development of characteristic symptoms was simultaneous with glandular hypertrophy—all of these were colloid. In the 5 cases where the exophthalmic condition developed secondarily, pre-existing glandular hypertrophy was noted during a period of six, ten, thirty-four, thirty-five, and thirteen years, respectively. In this series exophthalmic symptoms had been noted one, two, three, two, and two years prior to operation; average, one and four-fifths years. Duration of symptoms in the primary or pure Basedow cases prior to operation was two years, three months, two months, and one year; average, seven and one-quarter months.

Bilateral thyroid hypertrophy was noted in every case. In 2 it was recorded as slight, in 4 it was clearly noticeable, and in 3 the enlargement was exaggerated. The 2 cases of longest duration —thirty-four and thirty-five years—were of the cystic variety. Exophthalmos was manifest in 8 patients. In 4 this symptom was recorded as slight, in 2 distressing, in 2 exaggerated, and in 1 absent. Tachycardia in varying degree was present in every case,

and in 4 instances it was so manifest as to throw serious doubt upon the propriety of surgical interference.

Vascular disturbances, with associated symptoms, such as pulsation of cervical veins, arterial hum in the carotids and branches, interference with the sympathetic system manifest in abnormal glandular activity, in profuse perspiration; hyperæmia, local or general; alternate dryness and excessive moisture of the palms and soles; polyuria; digestive disturbances manifest in occasional attacks of diarrhœa were present in nearly every case. Psychic disturbances and neuroses of a somewhat vague character, which may be described as temperamental changes, undue excitability, intolerance of noise, weeping without adequate cause, capricious appetite, and the development of strong dislike for friends and relatives, were noted in more than half the cases. Two of the cases had experienced frequent well-defined suicidal impulses.

Dyspnœa of mechanical origin was uniformly present; slight in 4 and distressing in 5 cases. Deglutition was interfered with to a greater or less degree in 7 cases. Muscular weakness, especially in the musculature of the thighs and back, was of frequent occurrence.

In the first case ether was employed as an anæsthetic throughout the entire procedure. Its use was followed by symptoms so alarming that I determined to abandon it in subsequent undertakings. In the following 3 cases nerve-trunk cocainization was employed satisfactorily. In the last 5 cases Schleich's method was followed and found to be on the whole satisfactory. In very early cases, before extensive degenerative changes have occurred, it is probable that ether may be employed with reasonable assurance of safety; nevertheless, it cannot be too strongly urged that general anæsthesia will markedly increase the death rate if employed as a routine measure.

In this series 8 patients survived the operation and are now living; 1 patient died on the twelfth day. The 8 living patients have been carefully watched and the status definitely recorded up to date, and as the number is small I have deemed it proper to append a somewhat detailed account of each case as it occurred.

Although the first 4 cases were published in the *Annals of Surgery*, January, 1903, for purposes of this paper I thought it best to give a brief *résumé* of the condition leading up to treatment.

Case I.—A woman, domestic, aged twenty-eight years. Family history unimportant. Existence of thyroid disease extended over five or six years. Thyroid greatly enlarged. Patient complained of most of the classic symptoms; exophthalmos present to an exaggerated degree, heart conditions most distressing. Muscular weakness, especially in the erector spinæ and thigh muscles, very noticeable. Patient had abandoned work and was rapidly approaching helplessness.

*Operation* March 30, 1902. Right lobe removed. Patient made a quick recovery and improvement was satisfactory from the beginning. She gained weight rapidly. Blood and vascular conditions underwent a complete revolution, and she resumed work at the end of three months.

Condition after three years and three months: Patient has worked steadily as a domestic for the past two years and a half. Exophthalmos has disappeared; pulse rate is normal, and, in fact, all her symptoms are corrected, and the patient is well.

Case II.—An unmarried woman, aged forty years. Family history unimportant. Has noticed enlargement of the thyroid for one year and experienced dyspnœa. Expression anxious; is anæmic. Both lobes perceptibly enlarged; voice has undergone change; deglutition difficult; hacking cough; tremor and nerve symptoms especially noticeable; slight exophthalmos; temperamental changes marked.

*Operation* June 17, 1902. Left lobe removed. Patient made a quick recovery, and there has been no recurrence of former symptoms. At a recent interview she informed me that her health is ideal.

Case III.—Male, aged fifty-six years. Family history unimportant. Has used alcohol freely. For ten years had noticed an enlargement of left lobe of thyroid. At first this gave little discomfort, but during the past two years it has increased rapidly in size. Left lobe fills the entire left side of neck from clavicle to

inferior maxilla. There was marked exophthalmos; dyspnœa had become a prominent symptom, accompanied by a persistent cough and profuse expectoration, especially in the morning. Large bronchiectatic cavities were found in both lungs. Voice had undergone decided changes. Other classical symptoms of Basedow's disease were clearly in evidence. Patient's general condition was deplorable, and, although he continued in charge of his business as a merchant, every effort occasioned great distress.

*Operation* July 14, 1902. Removal of the left half of left lobe. Operative wound healed quickly, but relief of symptoms was somewhat delayed. Long pressure upon the trachea rendered dyspnœa persistent, and bronchial changes have never entirely cleared up. Gradually, however, he has attained a comfortable condition.

At the present time all his symptoms are greatly ameliorated, and the classical Basedow symptoms are entirely absent. The occasional attacks of coughing due to dilatation of the bronchi persist; otherwise his condition is satisfactory.

Case IV.—Married woman, aged forty-two years. Has always been a delicate person. For past seven or eight years has had an enlarged thyroid, which gave no special symptoms until one year ago, when typical Basedow symptoms were manifest. The patient is a fragile, anæmic, thin person, presenting all the typical signs of Basedow's disease. Exophthalmos very marked. Thyroid greatly enlarged bilaterally. Vascular, nervous, and temperamental symptoms very noticeable. Patient has been obliged to earn her living as a seamstress, but is unable to continue at her employment.

Three successive operations were done on the patient. The first was undertaken August 5, 1902, at which time the right lobe was enucleated. Owing to the desperate condition of the patient, removal of the left lobe was deferred. About six weeks later two-thirds of the left lobe were removed. Recovery from both operations was rapid; relief of symptoms slow, but continuous. Patient resumed work as a seamstress at the end of three months and continued to earn her living comfortably until March 14, 1905. The record at that time was as follows:

For the past two months patient has noticed a marked increase

in the remaining portion of the left lobe and a recurrence of Basedow symptoms, with general failure in health. At her own request I decided to remove the greater portion of the remaining thyroid structure. This was accomplished easily and there was an immediate improvement in every respect. Patient resumed work at the end of one month, and at the present time her condition, while not altogether satisfactory, is better than it has ever been since the first operation. Exophthalmos is still noticeable, but the eyes are less prominent, and this symptom is apparently disappearing gradually. She has gained weight; vascular and nervous conditions are fairly normal.

Case V.—Married woman, aged fifty-three years. For thirty-five years has had a large, bilateral, cystic goitre. For the past two years has developed classical symptoms of Basedow's disease. Exophthalmos very noticeable. Psychic conditions distressing. Muscular tremors, excessive thirst, and tachycardia manifest. Hair has fallen out to a marked degree. Marked dyspnœa. Respirations 24 when at rest. Breathing stridulous.

*Operation* October 29, 1902. Entire left and three-quarters of right lobe removed. Prompt recovery from operation. Relief of symptoms was manifest very early. At the end of one year had resumed her former weight, having gained nearly fifty pounds.

At a recent interview I found her condition entirely satisfactory. Exophthalmos had disappeared; respiration and pulse rate normal; entire absence of psychic symptoms.

Case VI.—Married woman, aged thirty-two years. For twelve years has noticed bilateral thyroid enlargement. I saw her in November, 1903. At that time she had suffered for about eighteen months with exaggerated Basedow symptoms. Patient had deteriorated rapidly within the past few weeks. Exophthalmos not very marked. Pulse rate varied from 120 to 160. Patient was extremely nervous; cried most of the time and without provocation. Dyspnœa very distressing. Heart greatly dilated. Entire loss of power of concentration; marked irritability. There was excessive thirst, frequent vomiting, and great muscular weakness. Her condition was so grave that the propriety of an operation was

seriously questioned. Feeling that she could not survive long in her then condition, I decided to undertake it.

On November 20, 1903, I removed the entire left lobe, which was very greatly enlarged and colloid in structure. Immediately following the operation she became uncontrollably nervous, which was relieved by morphine. Recovery from operation was prompt, as was the relief of her most distressing symptoms. Patient left the hospital at the end of six days in fairly good condition.

Since that time there has been noted gradual improvement. The patient is an artisan and pursues her calling without interruption. There has been no recurrence of former symptoms, and in every sense her condition is satisfactory.

CASE VII.—Married woman, aged thirty-nine years. Was always well until two years ago, when she noticed bilateral enlargement of the thyroid. There was immediate association of Basedow symptoms. Extreme nervousness, tachycardia, vasomotor disturbances, tremors, muscular weakness, irritability.

*Operation* April 5, 1904. Whole of right lobe and three-quarters of left removed. Symptoms during the subsequent forty-eight hours were such as to excite apprehension, but prompt recovery followed.

*June 1st.* Patient reported at office in excellent condition. All Basedow symptoms have disappeared. At that time she was on the point of leaving for South Africa, where she resides at the present time. I again heard from her about six months ago to the end that her health remains satisfactory, and there has been no recurrence of Basedow symptoms.

CASE VIII.—Male, aged fifty-one years. Patient first seen in July, 1904. At that time the left lobe of the thyroid was perceptibly enlarged, causing slight difficulty in swallowing and dyspnœa. Although the patient's general health was excellent, he complained of nervousness, slight exophthalmos, and muscular tremors.

On August 28, 1904, I removed the left lobe of the thyroid. Wound repair was prompt, and from the outset Basedow symptoms were abated. At the present time patient is leading an active life and has no symptoms suggesting the Basedow condition.

Case IX.—Married woman, aged forty-eight years. Family history: Mother died at seventy years, having been insane during the last three years of her life. (This fact I did not ascertain until after operation.) Patient had suffered for one year with persistent cough, rapid pulse, and dyspnœa. Some months ago there was noticed a bilateral enlargement of both lobes of the thyroid. Associated with this there was a slight exophthalmos. Patient became irritable and abnormally excitable. Polyuria was noted at times. Slight interference with deglutition. Patient is markedly attenuated, muscular weakness noticeable, condition generally bad. Five months ago right breast was removed for a benign tumor. Recently has been ill with an acute pulmonary affection.

On March 3, 1905, her general condition having improved, I removed the greater part of both lobes of the thyroid. Patient left the operating table in good condition and did well for the succeeding six days, during which time the wound healed per primam. Then there was a sudden change for the worse. She became extremely restless and totally irrational. Later she became comatose and died at the end of the twelfth day. This, the only fatality in the series, I believe to be accounted for partly.

While the fatal ending in this case must inevitably be attributed to thyroid intoxication, the advent of acute mania which was noted on and after the sixth day suggests strongly that heredity may have played an important role in the closing scene.

Analysis of the histories of the 8 living patients, from the standpoint of end results, has developed the following facts:

Exophthalmos was present in 7 cases. At the present time it is absent in 4 and notably lessened in 3. The average duration of the disease prior to operation in the first series was eleven months; in the second twenty-eight months. Hence it may be inferred that permanent deformity from this cause may be expected in long-standing cases.

Tachycardia disappeared after a few weeks in every case. The same statement may be made in reference to abnormal psychic manifestations, undue excitability, and associated phenomena. Recurrence of thyroid hypertrophy was noted in 1 case, necessitat-

ing a third operation thirty months after the second. It may be that a more radical removal of the right lobe originally would have obviated the final procedure.

Re-establishment of normal structural conditions as manifest in muscle repair, increase in weight and strength, and resumption of normal blood conditions has been uniformly slow. While in each case progressive improvement in these respects has been noted, Cases II. and IV. have been disabled to such an extent that they will never regain their wonted standard of health.

A wider experience in this particular field has increased my faith in the value of surgical interference in carefully selected cases; and in conclusion I wish to repeat what I wrote in an earlier communication: "The argument for early operation in malignant disease applies here with equal force. Extirpation should be undertaken before destructive tissue changes have occurred, before the function of important organs has been seriously, perhaps permanently impaired, and the patient's vitality lowered by chronic thyroid intoxication."

## DISCUSSION.

Dr. Roswell Park, of Buffalo.

I would say Amen very heartily to the last conclusion of Dr. Huntington; it pertains to so many conditions that come to us as surgeons that it cannot be made too impressive.

I have been wondering, as he read the paper, how we as surgeons should advise regarding exophthalmic goitre, and how we should regard it in connection with the new discoveries concerning the parathyroids. Is really the thyroid body itself at fault or the parathyroids? It is a question of very great importance to us, I think, and one upon which we are not yet decided. I hoped the essayist would consider that phase of the subject in his paper. If the parathyroids are at fault there is not much use in extirpating the thyroid, except as a means of exerting a little influence on these bodies. As to the parathyroids, many of them, as I reminded you yesterday in my paper, are embedded in the thyroid as are the islands of Langerhans in the pancreas. If the parathyroids have nothing to do with exophthalmic goitre, it simplifies matters for us a great deal.

Again, with regard to the extreme tachycardia in some cases which Dr. Huntington has reported, I have been wondering whether, after all, assuming that the parathyroids are at fault, it is not better to attack the sympathetic nerve rather than the thyroid itself. The difficulty here is insuperable, if we get the cases late. There can be no question as to the propriety of early intervention in these cases, because if we could get at the neck at the time when the thyroid mass is not too large, a prompt sympathectomy may do great good. It has been a question whether the Jonnesco operation, or excision of the cervical sympathetic, is not the best procedure. Here, again, we meet with a mechanical difficulty, inasmuch as that part of the nerve which has most to do with the heart is the lower cervical ganglion, and perhaps even the first dorsal. Later, when the neck is filled up with the enlargement it is not so easy to dissect away the mass and make access to the first dorsal ganglion.

I raise these questions, hoping that Dr. Huntington himself and some of the other Fellows will say more about them.

Dr. A. J. Ochsner, of Chicago.

My observation and experience in the surgical treatment of exophthalmic goitre extend back to the time when Kummel first began this form of treatment; I think it is a little over thirteen years now, and my

experience corresponds quite completely with that which Dr. Huntington has just given us. Of course, there are dangers associated with thyroidectomy. These are, in a general way, sepsis, hemorrhage, injury to the recurrent laryngeal nerve, and thyroidism. There are three points which I have observed that I wish to emphasize especially.

The first point is the rapid reduction in the pulse beat, provided little traumatism is inflicted to the substance of the gland during the operation. My first case, which has been well now for thirteen years, had a reduction in pulse beat from 140, which was the lowest that I found it at any time before the operation, to 70 or 80 afterward, which has persisted for this entire time.

The next point is one which was demonstrated by Dr. Crile, namely, that in using the inverted Trendelenburg position during the operation, but very little anæsthetic is required after the patient is once asleep. I always operate now under ether anæsthesia. We anæsthetize the patient thoroughly before the operation is begun, then place her in the inverted Trendelenburg position and complete the operation without any further use of anæsthetic. The patient remains asleep until the time when one approaches the recurrent laryngeal nerve. It can usually be distinguished as it passes over the inferior thyroid artery. If, however, the field has been covered with blood so that the little white cord cannot be distinguished readily, it is well to leave a portion of the thyroid gland that is attached directly to the trachea. It is a great comfort if the patient begins to speak at this point of the operation, as it assures one of the fact that the nerve is intact and it does not hurt the patient, as she does not remember the slight pain which occurs while still semiconscious. I believe that the benefit of operation without general anæsthesia comes from the fact that the patient will not permit the surgeon to crush and abuse the tissue of the thyroid gland during operation if she is not asleep. If one takes the same precaution of treating the gland with gentleness during the operation, avoiding crushing of the gland and squeezing the thyroid fluid into the circulation under general anæsthesia, I am certain that patients will do quite as well.

I have had a peculiar experience in regard to the use of iodoform gauze in these cases. Some years ago Kocher made the statement that in thyroidectomy no antiseptic whatever should be used. Before that time I had tamponed the raw surface with iodoform gauze and permitted the end of the gauze to protrude from the lower end of the wound, and the patients went on to recovery without any disturbance. Then, when this statement was made, I simply inserted a small drainage tube and used no iodoform gauze, but the patients did not do so well. That being

the only difference in the treatment, I went back to the use of iodoform gauze and my patients did better again. Very commonly the real cause of the difference in the progress of cases after operation has not been found, and this may simply be a coincidence, but so far it seems to be the real cause, and I know that my patients do as well as they did before the method was changed primarily.

Dr. William J. Mayo, of Rochester.

I was very glad that Dr. Huntington selected as the title of his paper "exophthalmic goitre." I think the first lesson which must be learned by surgeons, as well as medical men, is that exophthalmic goitre is a variety of Graves' disease, but that there are many cases of Graves' disease that are not due to exophthalmic goitre. To say that a certain person has Graves' disease is like saying that he or she has a fever, a condition, not an unvarying entity. There are a number of different causes for Graves' disease, of which exophthalmic goitre is merely one. No person should be operated for exophthalmic goitre because he or she may have Graves' disease, unless a goitre is present. In other words, operation should turn and is based upon the existence of a goitre, and not upon the fact of Graves' disease.

As was brought out in the excellent paper of Dr. Park yesterday, there are a number of different glands which have to do with the production of the symptoms of Graves' disease; it may be the increase of the secretions of one, or the reduction of another, which produces the symptoms we speak of as Graves' disease. This accounts for the difference of opinion of physicians in speaking of the cure of Graves' disease, and using these cases as an argument against operations for exophthalmic goitre. Exophthalmic goitre is a form of Graves' disease, but Graves' disease is not necessarily exophthalmic goitre.

The next thing to be learned in connection with this subject is that a considerable percentage of cases of exophthalmic goitre die without operation. In one year we refused to operate on four cases because they came to us too late. They suffered from marked anæmia, œdemas, and myocarditis. These patients all died shortly and must be counted as medical deaths. Every year we see such individuals and are compelled to operate upon other neglected cases which give a larger mortality. My brother (Dr. Charles H. Mayo) has paid considerable attention to this subject. He has now operated upon more than fifty cases and his experience leads us to believe that early operation gives splendid results and with little risk, especially in those cases in which a marked enlargement of the thyroid gland existed previous to the development of the symptoms of Graves' disease.

There is no doubt that a very considerable number of cases of myocarditis occur through the influence of rapid and long-continued excessive heart's action. The mortality in our first twenty-five cases was largely due to lack of appreciation of the importance of these contraindications. What can be done to get these bad cases into better condition for operation? The exhibition to the *x*-ray for a short time will improve some of them. Large, soft goitres, with marked exophthalmic symptoms and rapid pulse, will occasionally harden and shrink under the *x*-ray. Belladonna will do something toward reducing the heart's action of these patients when given internally for a couple of weeks before operation.

I agree with what Dr. Ochsner has said with regard to rough handling of the goitre as a cause of acute thyroid intoxication.

We are now using general anæsthesia more and more in these cases, thoroughly anæsthetizing the patient before beginning operation, allowing them to somewhat recover from it as we approach the recurrent laryngeal nerve. This permits of more rapid operating than under local anæsthesia, and in nervous, excitable patients it has given us better results. Local anæsthesia can be used with satisfaction in phlegmatic individuals. The actual percentage of deaths in our hands was as great after local as general anæsthesia, showing that the mortality is not influenced largely by the careful administration of a general anæsthetic.

The question of medical deaths is an important one. It must be remembered that we operate on only the bad cases in which medicine has failed. If we could get the cases earlier we would have a much smaller death rate.

One other point, and that is in connection with the use of carbolic acid over raw surfaces. If there has been an extensive raw thyroid surface made we use carbolic acid or some similar agent to check the absorption of the thyroid toxins from the wound at the time of operation.

Dr. Emmet Rixford, of San Francisco.

With reference to thyroidectomy in the treatment of exophthalmic goitre it is important to distinguish between primary and secondary exophthalmic goitre. By secondary exophthalmic goitre I mean when Basedow symptoms have been implanted on a pre-existing goitre, such as a thyroid adenoma. In these cases partial thyroidectomy or enucleation of the adenoma will be followed almost invariably by cessation of the symptoms. Relief does not follow in nearly so large a proportion of cases of primary exophthalmic goitre.

What Dr. Ochsner said about the use of iodoform gauze in the treat-

ment of exophthalmic goitre suggests the treatment sometimes employed in these cases, the internal administration of iodoform. I have seen at least one case in the practice of Dr. Williams, of Oakland, Cal., in which marked improvement in weight, pulse rate, and general strength occurred.

Dr. Albert Vander Veer, of Albany.

I wonder how many in this room remember seeing an operation for the removal of the thyroid thirty-six years ago, and the method and manner of doing the operation at that time? My first operation was done about then, and was a case of exophthalmic goitre, although I did not know the pathology. I operated with thumb forceps. An incision was made, followed by excessive hemorrhage, and I picked up the vessel and tied it as I proceeded step by step. The operation was done at the house of the patient, and the surroundings were not good. But it was a case that gave me some standing among the older men in my own city as an operator. I do not hesitate to speak of that now.

The second case was operated upon soon after I saw Sir Spencer Wells use the hæmostatic forceps. I modified this forceps soon afterward, making a sharper point. With this I operated on my second case of exophthalmic goitre, the patient being a young woman. The operation was smooth, and there was no danger from hemorrhage. I made a thorough and complete removal of the thyroid on both sides. This patient developed myxœdema within one year thereafter. I had some few cases of exophthalmic goitre in which I operated afterward, and I supposed I was getting on very nicely until two years ago, when I operated upon a patient who had been under treatment in different parts of the State; she was brought a distance of one hundred miles from an adjoining city. The family physician asked me to operate, as he had seen some of my operations for exophthalmic goitre, and knew that I had been fortunate in getting good results. The patient had a large thyroid, with enormous protrusion of the eyes, and a pulse which we could not reduce below 140. I removed the entire right side and a part of the left; and since myxœdema developed in one of my cases it has been my habit to leave a portion of the thyroid. She passed through the operation very well, but the pulse went up to 180, and, as has been suggested, I had great faith in the use of morphine after operation, but it did not benefit this patient. I have reason to believe that infection came from the remaining portion of the lobe that was left, or that this was the cause of the infection in this case. At any rate, the woman died at the end of seventy-two hours. This was my first death, and the only one in the number of cases I have operated on. As I was not prepared to discuss this subject, I do not recall how many cases really I have operated upon. But within the past year a patient was

brought to the hospital, upon a stretcher, with an immense thyroid, an operation for which I would not have undertaken eight years ago. I kept the patient under observation for a few days. Heart tonics were given. She had a most remarkable condition. She lay in bed, and in examining her, in turning the head to the left side where the enlargement was, the least possible movement would cause her to pass into a condition of syncope. Her husband informed me that when she turned her head to the left side she would faint, which to me was a rather peculiar symptom. The case, however, was one in which I operated, and I have never had a patient do better, progress so rapidly until she went on to complete recovery.

Dr. Huntington. I want to say, first, in answer to Dr. Park's suggestion with regard to the parathyroids, that there is along this line a field for work, and one which has not been by any means explored sufficiently. I have no doubt that in the future we shall know more about parathyroids and analogous structures throughout the system. But my reading has not been broad enough to base any opinion upon the value of that work, and for that reason I did not allude to it in my paper. For the same reason I did not allude to modern medication and medicaments, such as dethyroidized goat serum, etc. I have no faith in its permanent effect. It may produce a little better condition temporarily, or a condition of latency and thereby prolong the disease. Where we have the disease well defined, as in many of these cases, we can accomplish more by surgical than by medical means.

There are cases in which we can say that they can be handled safely under ether anæsthesia. I think Dr. Crile has demonstrated that conclusively. There are others which can be operated with tolerable safety without ether, and its administration is always followed by disastrous results. We do not kill with the operation, but we do kill with the anæsthetic. I am perfectly sure that two of my own patients who recovered promptly without ether would have died if ether had been administered.

Just a word or two more in closing. In the future we shall see less large thyroids than we have seen in the past; we shall see less of the distressing, disastrous consequences of thyroid poisoning in the future than we have in the past. We are going to see a revolution similar to that which has occurred in relation to large abdominal tumors. We do not find fifty-pound tumors any more in the abdominal cavity; neither shall we find the head of patients forced backward, with eyes markedly protruding because of long-protracted disease of this sort. The surgeon in the future will be willing to assume authority and jurisdiction over this kind of work, and it will be more freely accorded to him by his colleagues.

# A REVIEW OF FIVE HUNDRED CASES OF GASTRO-ENTEROSTOMY, INCLUDING PYLOROPLASTY, GASTRODUODENOSTOMY AND GASTRO-JEJUNOSTOMY.

By WILLIAM J. MAYO, M.D.,
ROCHESTER, MINN.

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The writer has included in this series all of the cases in which there has been an incision made into both the intestine and stomach and plastic union established between the two organs with the intent to increase gastric drainage. The term gastroenterostomy is used in its literal sense, the formation of an artificial passage between the stomach and intestine; the terms pyloroplasty, gastroduodenostomy, and gastrojejunostomy being used as expressing more accurately the exact method employed.

The series of cases have been worked out with a view of showing the actual results of operation, both as to mortality and the percentage of secondary operations. The method of computing mortality herein followed is to charge as a death from operation every individual dying in the hospital, without regard to cause of death or length of time after. It includes deaths occurring as long as three months after operation, from coincident chronic nephritis, etc., and might be called the combined mortality of operation and disease. This works a hardship on the statistics, but it eliminates the personal equation. The statistics include every case Dr. Charles H. Mayo and myself have operated upon up to June 20, 1905, the early cases showing a particularly high mortality. The secondary operations were repeated in some instances two to five times before good results were obtained, so that the number of

secondary procedures was nearly double the number of cases reported.

Pyloroplasty, 21 cases. No deaths; 7 secondary operations (33.33 per cent.).

Gastroduodenostomy: Finney, 58 cases; 4 deaths (6.9 per cent.); 2 secondary operations (3.4 per cent.).

Gastrojejunostomy, total 421; 307 benign, 19 deaths (6.2 per cent.). In the last 140 there were 4 deaths, a mortality of 2.67 per cent. Last 80 cases gave but 1 death; 114 malignant, with 21 deaths (18 per cent.). Of these 114 cases, 63 were in connection with pylorectomy and partial gastrectomy, with 8 deaths (13 per cent.). The very unfavorable cases of cancer obstruction were subjected to gastroenterostomy, so that this operation gives a higher mortality than radical excision. In the last 40 gastrojejunostomies for malignant disease the mortality was 8 per cent. In the 421 gastrojejunostomies, there were 21 reoperated cases (5 per cent.).

Pyloroplasty. The pyloroplasty of Heineke-Mikulicz, in our experience, has but little risk in suitable cases, but is open to objection. It enlarges the calibre as much in an upward direction as downward in the line of drainage, and the extent to which this enlargement can be carried out is limited. The pylorus following this operation is exceedingly prone to become adherent, so that the opening remains at a high level. The stomach, if greatly dilated, must elevate the food to the high-lying outlet, and it frequently happens that the degenerated muscle fibres are incapable of the muscular effort, and, as a result, the patient is not materially benefited. In 3 cases we fastened the pylorus after operation to the region of the umbilicus by suture, to secure a low drainage point, taking advantage of the fact that adhesion after operation was the rule to secure fixation at a more favorable situation. These 3 cases have continued in good health, but there are valid objections to the plan. In the 7 cases which came to secondary operation the adhesions were most marked. Gastrojejunostomy in each case resulted in cure. In the remaining 14 cases cure resulted. In 4 cases an ulcer was excised at the same time with

favorable result. Pyloroplasty has a small field of usefulness, but in performing it the later plan of Mikulicz should be adopted. The incision should be curved downward upon both the stomach and duodenum, much like the Finney method, the result being to give an increased calibre over pyloroplasty as ordinarily performed and establishing better drainage lines.

The principle in plastic union, established by pyloroplasty, is one of the first importance and widely used in surgery. It is especially valuable in choosing the line of closure after excising gastric ulcers, etc.

Gastroduodenostomy. Strictly speaking, this operation implies a separate opening between the stomach and duodenum, such as Kocher's gastroduodenostomy, but as the method of Finney more easily answers the same purpose, we have followed this plan in the entire group of 58 operations, with 4 deaths and with 2 secondary operations (mortality, 6.9 per cent.); (secondary operations, 3.4 per cent.). In the first 46 cases there was only 1 death; in the next 12 there were 3 deaths. It does not seem fair to count 2 of the deaths, as 1 was from pneumonia after complete recovery, and 1 from embolus, due to an old endocarditis. We had an opportunity to re-examine the operated field in 3 individuals after a number of months; there were extensive adhesions present in 2.

Subjects for this operation should be carefully selected; extensive disease, adhesions, a short gastrohepatic omentum, and especially the presence of scar tissue, should be considered a contraindication, as it is in just this variety that gastrojejunostomy gives the most satisfactory results. Two of the four deaths we had were due to suture leakage, on account of tension in scar tissue.

In open ulcer the food must still pass the ulcer area to reach the pylorus, and ulcer does not depend on obstruction, as shown by the frequency of duodenal ulcer beyond the possibility of obstruction. Reasoning on this ground, we would not expect the curative results from gastroduodenostomy in active ulcer which we would get from gastrojejunostomy, made to the left of the ulcer-bearing area, and our experience bears this out; in this class of cases it has not given the same measure of relief. The importance

of this objection is somewhat minimized by the fact that the line of enlargement is not only downward in the line of drainage, but also along the greater curvature, which is seldom involved in ulcer. The opening can be made of ample size, and it avoids the risks habitual to gastrojejunostomy, as it leaves the outlet at its proper situation. We were enabled, in 4 cases, to combine with the Finney operation an incision of the ulcer.

There were 2 secondary operations in this group; in both individuals bile chronically came into the stomach, causing distress. We had made the opening too large, as shown at reoperation. One case had severe hemorrhage from insecure suturing, and required reoperation in twenty hours with recovery.

Gastrojejunostomy. Gastrojejunostomy, 421 cases. Benign, 307 cases, 19 deaths (6 per cent.); second operation, 20 (6.5 per cent.); malignant, 114 cases, 21 deaths (19 per cent.); 1 second operation (9 per cent.). Of these operations, 63 were made in connection with pylorectomy and partial gastrectomy.

The writer has been greatly interested in gastrojejunostomy. No operation in surgery has conferred greater benefit upon suitable patients than this one. Unfortunate experience, however, sharpened the investigation as to the causes of deaths and the complications which we found to be more or less inherent in every method of operation with which we became acquainted. In all but 3 of the fatalities, a postmortem investigation as to the cause of death was obtained.

It has only been of late that we have secured a method which could be depended upon to give good results steadily with a sufficiently low mortality to justify the operation in cases in which disability, rather than impending death, was the spur to operative relief.

The first claim to investigation comes with the question, Shall the operation be made anterior after Wolfler, or posterior after von Hacker? Of the total number of cases, 126 were anterior and 295 posterior. The mortality in the anterior group was somewhat over 1 per cent. higher than in the posterior, but the percentage of secondary operations was greater after the posterior. The

mortality comparison is, however, hardly fair to the anterior method, as this group comprises a larger number of the early operations in which inexperience can be blamed for some of the misfortunes.

For benign disease the posterior plan is the one of choice. It is applied at a higher point on the jejunum, and is unattended with the risk pertaining to the presence of the loop which must surround the transverse colon. That this loop is of dangerous import is shown by 2 of our secondary operations, in 1 of which a number of feet of small intestine travelled through the noose, and in the second death was directly traced to adhesion and obstruction of the transverse colon. The length of this loop is from sixteen to twenty inches, a disadvantage when one considers the proportionally high value of the upper jejunum in digestion and absorption. The anterior operation has some few indications. In cancer the disturbance is less, and, as the gastric juice has little acid, the patient cannot be expected to live long enough to develop a secondary jejunal ulcer. The anterior operation is more liable to be followed by contraction on account of the traction weight of the attached intestine, a diverticulum formation of the intestine takes place, which is followed later by contraction. Such reduction in calibre happens most frequently after the button, as the line of union is narrow and it has less of a grasp on the tissues. Contraction, however, is liable to occur after any form of operation, especially if the pylorus is unobstructed.

Nature tends to close the opening, no matter what form of operation; but the shorter the loop the less the probability of narrowing, and in the operations without a loop we would not consider it a serious question. We have seen a reduction of one-half take place three and five months respectively after a Moynihan operation on a nine-inch loop.

Vicious circle, as the regurgitant vomiting is generally known, is less liable after the anterior than the posterior operation. The traction weight of the attached intestine tends to keep the bowel pulled away from the stomach, while after the posterior operation there is a greater tendency for the development of a kink or flatten-

ing of the intestine against the opening (Cannon and Blake). In spite of the objections which we present to the anterior operation, we have a large number of operated cases after this method in perfect health for periods of time up to twelve years.

Angulation and obstruction are the two great causes of regurgitant vomiting, and in our experience, the short, posterior loop of from seven to ten inches gave the greatest number of such complications. Acute, vicious circle occurs very rarely, if the opening be placed at the lowest point of the gastric cavity, but a considerable number of patients begin to have trouble, usually within two or three months, as pointed out by Ochsner. This condition often increases, and in from six months to a year gives sufficient annoyance to require a secondary operation.

Murphy button, total, 157 operations. Benign, 72 operations, 6 deaths (8 per cent.); 54 anterior, 4 deaths (8 per cent.); 4 reoperations, (8 per cent.); 18 posterior, 2 deaths (11 per cent.); 4 reoperations (8 per cent.); malignant, 85 operations, 15 deaths (18 per cent.), including pylorectomy and partial gastrectomy.

The Murphy button is least liable to be followed by passage of bile into the stomach. While in position it mechanically prevents kinking, and the character of the permanent opening does not favor angulation. Four of the deaths were caused by pulling apart of the attached surfaces in from six to ten days subsequent to operation and after the button had loosened and passed along the intestine. We now always protect the button union by four or five mattress sutures of silk at intervals. A continuous suture outside the button may prevent its passing out of position and cause it to lodge and act as a foreign body. If it were not for the frequent retention of the button in the stomach the posterior button method, without a loop, would be ideal. Twice we have had to remove a retained button for symptoms. After pylorectomy and partial gastrectomy for cancer we nearly always employ the button. It gives an immediate opening and is particularly free from secondary complications. In 1 out of 3 direct anastomoses by the Kocher method, between the duodenum and stomach

after partial gastrectomy, a second operation was required in eight weeks to relieve angulation and obstruction.

McGraw ligature: total, 36 operations. Benign 17, 2 deaths (11.7 per cent.); malignant 19, 3 deaths (15.7 per cent.). We have used Ochsner's technique and found it very satisfactory.

The McGraw ligature method anterior has been very free from bile regurgitation and is exceedingly safe. It can be placed in bad tissues and can be used in poor subjects. We have four times performed this operation with a hæmoglobin of less than 25 per cent.; once 20 per cent., and once 24 per cent., in bleeding ulcer, with recovery; once with the hæmoglobin 24 per cent. in cancer with acute obstruction, with recovery; once with hæmoglobin of 10 per cent. in cancer with hemorrhages simulating ulcer. The latter case was scarcely conscious at time of operation. He lived four days, and although a stout, heavy, rubber cord was used and tightly tied, there was no sign of an opening at the postmortem. It requires some vitality to cause the tissue to cut through. This man did not have sufficient resistance to set up atrophy necrosis, and the result was the same as in a cadaver. Two cases of cancerous obstruction with a considerable quantity of free fluid in the abdomen recovered after a ligature operation. Tissues which are of poor vitality, but which have some power of repair, will do so after a McGraw ligature. The button might set up an uncircumscribed slough or the suture become easily infected if these methods were chosen. The McGraw operation, including opening and closing the abdomen, can be done in twelve minutes without hurry. The disadvantages are that it should be or has been used with the loop, and, like any loop operation, the opening may contract. We had 1 case of acute regurgitant vomiting after the McGraw ligature, which was reoperated on the fourth day. The ligature had been badly placed and the opening lay at one side of the centre of the bowel.

Posterior suture: total, 228 operations; 10 malignant, with 2 deaths (20 per cent.); 218 benign, with 11 deaths (5 per cent.).

We do not do an anterior suture operation. The increased risk of contraction and jejunal ulcer which unavoidably attends the

anterior operation would, with the suture, also increase the chances of bile regurgitation.

In May, 1901, Mr. Robson demonstrated the bone-bobbin operation, with the suture on a posterior ten-inch loop. We did 15 by this method, with 1 death, and found it very satisfactory.

In June, 1903, the late Prof. Mikulicz advocated the short-loop method, three or four inches in length, and used the transverse incision. We made 43 by this method, with 4 deaths, 2 of which could be fairly excluded. Four required a second operation at our hands, and to a large extent because we departed from the originator's technique. It came about in this way: The transverse intestinal incision limits the size of the opening to one-half the diameter of the intestine, less about one-fourth inch suture line, and the opening could seldom be made larger than could admit the invaginated thumb. We tried to enlarge this by encroaching on the bowel and caused a valve to form, which turned the bile into the stomach. These patients gave us a lot of trouble; the short upper limb of the loop made an ordinary enteroanastomosis of the two arms of the bowel impossible. We finally united the intestine each side of the opening in exactly the same manner as the Finney operation at the pylorus. The result was good. This was our first experience with the short proximal loop; the cases which recovered after this operation have remained in splendid condition, despite the small opening. In October, 1903, Dr. Charles H. Mayo did 2 operations with a longitudinal, intestinal opening without a loop and as short as possible, practically the operation we are doing now. Both recovered and remain well.

In the summer of 1903 Mr. Moynihan demonstrated the method he was using with the clamp and which goes by the name of the "Moynihan operation," using the oblique, posterior incision of the stomach wall and a nine-inch loop. The use of the clamps simplified the technique, and the opening could be made very large. We made 53 operations after this method, with 3 deaths. The primary results with the Moynihan operation were good. Not a case of acute vicious circle, but in the course

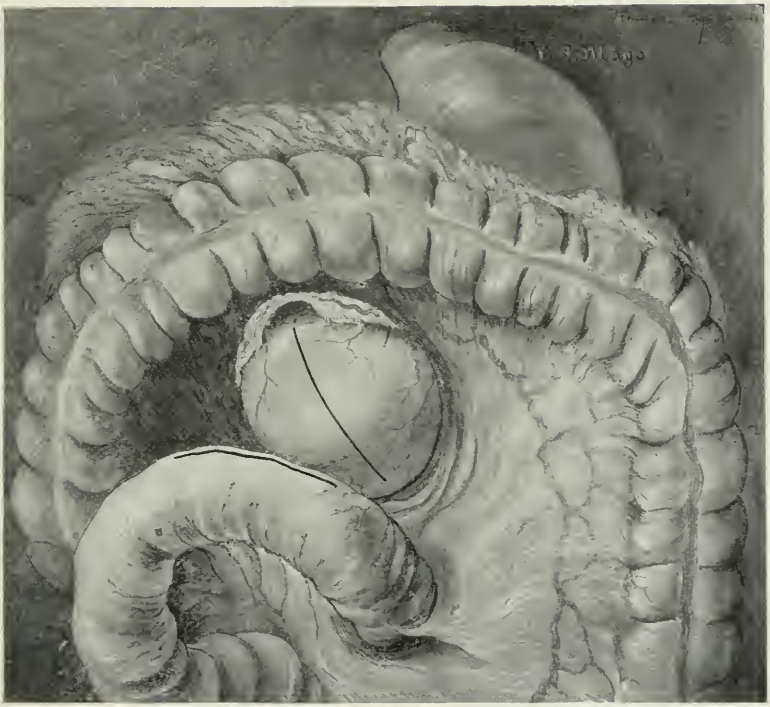
of a year 7 cases required a second operation for the distress caused by bile regurgitation, either occasionally in large quantities or frequently in smaller amount. In June, 1904, we began the operation on the Roux principle, doing a posterior gastrojejunostomy on a nine-inch loop with enteroanastomosis. The proximal loop was then obstructed (*a*) by Scott-Matolli suture, (*b*) Fowler's silver wire, (*c*) division of intestine, turning in both ends after Doyen. There were 48 of these, with 2 deaths. Two required a second operation; in 1 the silk suture in the longitudinal pleating had passed into the intestine. The infection caused adhesions, angulation, and bile regurgitation. In the second in which the proximal intestine had been divided the cut end intussuscepted through the upper part of the lateral anastomosis, causing obstruction. This complicated operation was of too serious a character to apply to every case, requiring from forty-five to fifty minutes for its performance, and January 1, 1905, we began the routine use of the posterior suture operation without a loop, in the same manner as used in the 2 cases operated upon by Dr. Charles H. Mayo in October, 1903.

The operation of choice is without a loop; 56 operations up to June 20, 1905, 1 death (1.8 per cent.).

This operation became popularized by the writings of Peterson, of the Heidelberg clinic, Czerny having used it for years, usually with the Murphy button, and with splendid success. At the time Peterson brought out the favorable features of the method we had practically abandoned the button for the suture in benign disease, and the operation could not be easily done with a longitudinal opening without the holding clamps which Moynihan and Littlefield later popularized. Mikulicz, as already pointed out, was doing the operation with the transverse incision.

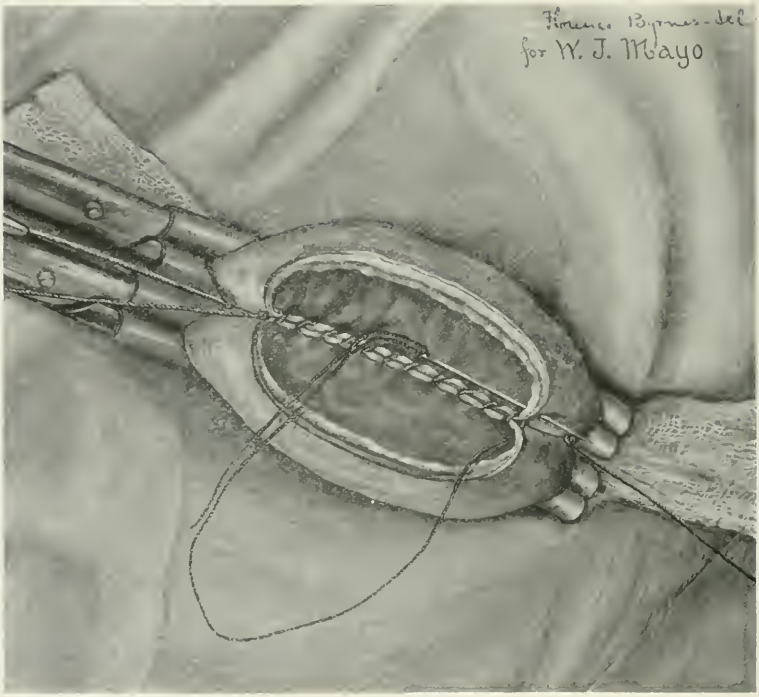
To properly appreciate the advantages of the "no-loop" method, some physiological and anatomical facts must be understood (Fig. 1). The stomach is not a bag but a muscular organ, and when empty the pylorus is not far from the lowest point, and lies nearly in the median line of the body. As the stomach distends the organ becomes more nearly horizontal by the elongation of

FIG. 1.



Showing posterior wall of the stomach drawn through a rent in the transverse mesocolon. Note slight separation of gastrocolic omentum from its attachment to the stomach, permitting anterior wall of stomach to appear, and insuring drainage at lowermost level. Black lines mark site of proposed anastomosis; the jejunum shows at its origin.

FIG. 2.




Forceps in place and anastomosis half completed by suture.

FIG. 3.

Completed operation from behind margin of torn mesocolon attached by several interrupted sutures to line of union.

FIG. 4.

Completed operation from in front. Anastomotic opening shows through as darkened area on posterior wall. Note that it goes to the bottom of the gastric cavity and slightly anterior, as indicated by suture line in the omental attachment.

the greater curvature. The pylorus passes to the right of the median line and relatively passes above the greater curvature. The gastroepiploic artery sets away from the greater curvature about three-fourths of an inch when the stomach is empty and sends its gastric branches upward on the anterior and posterior gastric wall, which it meets above the actual line of the greater curvature. This arrangement of the bloodvessels enables rapid distention of the stomach without interference with the blood supply. The lesser gastric curvature is more fixed in position and can be divided into two parts; the perpendicular portion which drops nearly vertically from the right margin of the cardiac orifice (about one and a half inches to the left of the midline), and the horizon or slightly curved portion, which turns sharply to the right and ends at the pylorus. Ordinarily the concavity of the lesser curvature is from two to three inches, the corresponding point on the greater curvature being three and a half to four and a half inches, making the convexity of the pyloric segment. This is the grinding, muscular part of the stomach, the part subjected to the greatest amount of traumatism, and over 80 per cent. of all the lesions for which we are called to operate are either in this part or in the first two and a half inches of the duodenum. The gastrojejunostomy opening should be placed just to the left of this portion of the stomach (Fig. 2).

The inferior margin of the gastrojejunal opening should lie at the greater curvature, on a line opposite the juncture of the transverse and longitudinal parts of the lesser curvature. This is rather farther to the right than has usually been practised. The duodenum passes through the mesocolon, nearly on a perpendicular plane with the cardiac orifice, one and a half inches to the left of the midline, and when the stomach is empty its lower border lies nearly on a line with the origin of the jejunum. When the gastric cavity is distended or dilated it descends and covers this point. The proper situation of the gastric opening would be oblique on the posterior wall, beginning on the body of the stomach between lesser and greater curvatures and extending downward to the very bottom of the stomach, Moynihan's line (Figs. 2 and 3). To

ensure that the opening shall be at the very lowest point at its right margin, we slightly separate the omentum from the greater curvature and pull a quarter to a half inch of the anterior wall out posteriorly, pushing the gastroepiploic vessel out of the way (Fig. 4).

In previous contributions to this subject we have called attention to the changed nature of the proximal arm of the jejunal loop after gastroenterostomy. It becomes succulent and thick. With a loop gastroenterostomy the food could and did pass into the proximal loop, while the peristalsis of this short end was inefficient, and herein lay most of the difficulties. Peterson developed the fact that if the jejunum were attached short without a loop it would require a reverse peristalsis to carry food into the duodenum. Peterson's point of jejunal election lies within from one to three inches of the origin of the jejunum, varying as necessary to enable easy attachment to the stomach (Figs. 1 and 2). It will be noted that the line of proposed union is a natural one. The intestine comes off the bottom of the stomach as though it were mortised on, the opening extending upward and to the left. As Cannon and Blake have experimentally proven, and we have clinically demonstrated, the food will pass out the unobstructed pylorus after any method of gastrojejunostomy; with this method of operation it makes little difference. Spasm of the whole pyloric end of the stomach, which quickly follows ulcer or other irritation, no longer holds back the food and secretions. The gentle compressing action of the cardiac end is quite sufficient to turn the secretions and delayed ingesta out of the gastroenterostomy. Relief of the pyloric obstruction, no matter what its character, permits normal progress. Interruption of this calls the new opening into use. It is not at all necessary for the chyme to enter the duodenum to stimulate pancreatic and biliary discharge. This happens whenever the gastric product enters the small intestine at any point. In all the loop operations more or less of the jejunum, at its most important situation, is thrown into a by-channel. The opening of the common duct lies four inches below the normal pyloric entrance of food. This operation brings the common duct opening eight inches above the

gastrojejunal food entrance, and the constant presence of biliary and pancreatic alkaline secretions will certainly render secondary jejunal less frequent than primary duodenal ulcer.

To recapitulate:

1. The gastric opening should be placed on the posterior wall, obliquely from above downward, and left to right (Fig. 1, Moynihan's line).

2. The lowest point of the gastroenterostomy should be at the lowest point of the stomach, on a plane perpendicular with the cardiac orifice (Fig. 1).

3. To ensure this effect the gastric incision should extend a quarter to a half inch onto the anterior wall. The jejunum is mortised onto the stomach (Figs. 1, 2, 3, and 4).

4. The incision in the intestine should be longitudinal, opposite the mesentery, and begin from one to three inches from the origin of the intestine, measuring on the anterior surface (Peterson's point of election, Figs. 1, 2, and 3). The exact distance depends on the ease of attachment, as short as can be conveniently done without tension.

A description of the operation is, briefly, as follows:

(*a*) The abdominal incision is made four inches in length, three-quarters of an inch to the right of the middle line, the fibres of the rectus muscle being separated. The lower end of the external wound lies just above the umbilicus. This opening enables inspection of the duodenum and gall-bladder and is reliable against hernia when closed.

(*b*) The transverse colon is pulled out and the mesocolon made taut by traction upward and to the right, in this manner bringing the jejunum out at its origin.

(*c*) About three to four inches of the jejunum opposite the mesentery is drawn into a slightly curved clamp (Fig. 5). The handles of the clamps should be to the right to enable a short grasp on the intestine. Three-quarters of the circumference of the bowel is pulled through; the posterior border is not included, to prevent entanglement of the suture with the redundant posterior mucous membrane. The holding clamps are applied sufficiently

tight to check hemorrhage and prevent extravasation of intestinal contents.

(*d*) The ligament of Treitz is a short muscular mesentery covered by a variable peritoneal fold (too variable for a reliable landmark), extending upward from the origin of the jejunum on to the mesocolon. This peritoneal fold lies at the base of the arterial loop of the middle colic artery, which supplies the transverse colon. The mesocolon is opened within the vascular loop and the posterior inferior border of the stomach pushed through. A small separation of the greater omental attachment to the stomach enables the anterior gastric wall to be drawn out posteriorly. The posterior gastric wall is drawn into the clamps with the handles to the right in such a manner as to just expose the anterior wall at the base.

(*e*) The two clamps are laid side by side and the field carefully protected by moist gauze pads. With fine celluloiden linen thread on a straight needle the intestine is sutured to the stomach from left to right by a Cushing suture at least two and a half inches.

(*f*) The stomach and intestine are incised a sixth inch in front of the suture line, and the redundant mucous membrane excised flush with the retracted peritoneal and muscular coats. With a No. 1 chromic catgut on a straight needle the posterior cut margins of the entire thickness of the gastric and jejunal wall are united by a button-hole suture from right to left; at the extreme left the suture changes to one which passes through all the coats of each side alternately, from the peritoneal to the mucous, then directly back on the same side from the mucous to the peritoneum. This acts as a hæmostatic suture and also turns the peritoneal coats into apposition. It passes around the anterior surface and is tied to the original end, which has been left long for the purpose. If silk or linen is used for this suture it may hang *in situ*, suppurating for months.

(*g*) The clamps are now removed and the linen thread continued around until it is tied to the original end, firmly catching the bloodvessels in sight along the suture line. The parts are carefully cleansed and inspected. If necessary a suture or two is applied to accurately coapt or to check the oozing.

(*h*) The margins of the incised mesocolon are now united to the suture line by three or four interrupted sutures and the parts returned into the abdomen.

After-treatment. On being placed in bed a glass female douche point is passed just above the internal sphincter ani and attached to a gravity bag filled with a half strength normal salt solution. The elevation should not be greater than six inches. The small stream passing into the rectum is readily absorbed without irritation. One or two quarts are taken up in an hour (Murphy). The patient is then placed in the semi-sitting posture. Beginning in sixteen to twenty hours, an ounce of hot water is given every hour; this is rapidly increased, and in thirty-six hours the usual experimentation with liquid feeding is instituted. Rectal feeding is unnecessary.

We are much indebted to Munro and Bottomly, of the Carney Hospital, Boston, for suggestions in technique, as elaborated above, and for the opportunity they have afforded Miss Burns to make the drawings herein shown from actual operations at their hands.

Note.—W. H. Wathen, in the *Journal of the American Medical Association*, June 17, 1905, gives an excellent *résumé* of the recent literature of the subject.

## DISCUSSION.

Dr. Thomas W. Huntington, of San Francisco.

I rise more to express my appreciation of this paper and the method of presentation of the subject than to offer anything in addition to what has been said. There is one point in the paper that impressed me deeply, and that is the value of the operation if it can be done successfully. When it is possible to take a patient who is practically moribund, whose condition evidences rapid approach to dissolution, after every effort to protect him from starvation has been resorted to, place him upon an operating table, relieve the obstruction, and within five days find him taking food readily with relish, and within ten days or two weeks resuming a promiscuous dietary, and at the end of eight weeks showing a gain of twenty-seven pounds in weight, it seems to me such a statement should have much weight in establishing the legitimacy of the procedure. This has happened to me, and it has happened to most of us. For that reason I desire to express the hope that the method which Dr. Mayo has suggested and which I have personally followed, without the proximal loop, may give us the final solution of the situation and enable us to repeat the pleasant experiences and avoid the very positive humiliations that have attended some of the work of this class.

Dr. W. L. Rodman, of Philadelphia.

I am sure that we have listened with a great deal of pleasure to the paper and demonstration of Dr. Mayo, knowing, as we do, that no man is more entitled to speak on this subject in an *ex cathedra* way than he. It is useless to emphasize the good points which he has already made in connection with this method of doing gastroenterostomy. I think we are practically all agreed, at the present time, that shortening of the loop or its elimination altogether is absolutely necessary. It seems a little strange, however, that we have not been doing this for a longer time. The fact that we formerly met vicious circle by enteroanastomosis ought to have been a sufficient lesson to us earlier that the loop should be made less long primarily. Since I have done the operation in the manner described I have not seen the vicious circle.

There are two points that I wish Dr. Mayo had spoken of in connection with his modification of the Moynihan-Littlefield operation, because they are of value. Recently while in Rochester, Minnesota, I had occasion to see Dr. Mayo do several of these operations. In every respect they were like the operation of Moynihan, whom I saw operate

three years ago, except in two or three respects, two particularly. In the first place Dr. Mayo takes no chance in bringing the stomach from the lesser cavity. He locates the point where he wishes to do the anastomosis with forceps, and pulls the stomach through. By doing this one takes no chance whatsoever of making the opening at any other than the lowest and most dependent portion of the stomach, where the best drainage can be effected. It struck me as being an excellent point, and ensures drainage being established at the lowest part of the stomach.

Another modification, and a material one, is that in making a suture he uses chromic gut for the hæmostatic suture instead of the Pagenstecher, having observed that in a certain number of cases the Pagenstecher suture remained a long time and was a possible source of mischief. He also makes that suture in a different way from that ordinarily employed and uses a straight needle. I am sure that anyone can shorten the operation by ten minutes if they will use a straight needle, if they have been in the habit of using a curved one. Mr. Moynihan uses and insists upon the use of a curved needle.

Dr. A. J. Ochsner, of Chicago.

There is no doubt but what the advance in stomach surgery of to-day in this country is due largely to Dr. Mayo's teachings. We have learned important points in stomach surgery repeatedly from Dr. Mayo, and again to-day we will learn from this paper, which will have to be read many times before we can master all of the lessons it contains. Stomach surgery is not nearly complete and there will be more progress in the future.

Dr. Mayo mentioned one thing which I must correct in reference to the technique in using the McGraw ligature. I have no particular technique in using this ligature; it is essentially the method Dr. McGraw showed me, which was beautifully illustrated by Dr. Walker in the *Journal of the American Medical Association*, only I have been talking about it so much that Dr. Mayo and others have come to the conclusion that I have developed something different.

There is one point I wish to speak of, which Dr. Mayo mentioned, namely, the occurrence of jejunal ulcer. In studying the question of jejunal ulcer you will find that this condition occurs after anterior gastroenterostomy more commonly than in the posterior operation.

This is true because the principle which Dr. Mayo pointed out some years ago, according to which the opening must actually be made in the lowest point in the stomach, can be carried out with much less difficulty in the posterior than in the anterior operation.

In making the anastomosis with the needle and thread one always

works away from the lowest point in the anterior operation, while one works toward the lowest point in the posterior operation. This makes a difference of at least two centimetres in favor of the posterior operation.

This difference can, of course, be overcome by carefully calculating the distance the opening will be shifted during the operation.

In this manner peptic ulcers can be avoided, no matter whether the anterior or posterior operation is performed.

The ulcer comes from the accumulation of a considerable quantity of acid in the stomach and the consequent application of a considerable quantity of this acid to the mucous lining of the jejunum without the proper neutralization because of the absence of bile and pancreatic fluid. We know physiologically that an acid indigestion is stimulated by the presence of a small amount of acid; in other words, the stomach will not become severely acid unless you start the acidity.

Whenever the anastomosis opening is not at the lowest point in the stomach there is always a pouch in which the acid can accumulate. This provides for the secretion of an abnormal amount of acid, and when the stomach contracts there is a great quantity of this to be forwarded into the jejunum at once, which undoubtedly accounts for the presence of peptic ulcer in the jejunum following gastroenterostomy.

Dr. Albert Vander Veer, of Albany.

I have seen abdominal surgery develop. In my time, I have witnessed the invasion of the cavity of the peritoneum with timidity on the part of men who were recognized as bold and brave surgeons. I have seen men who have reported their cases as they have advanced in doing surgical work within the abdomen, and all of us have been able to classify in our minds the operations that have been introduced from time to time and have commanded respect, and which we have been able to follow out, and the results have proven that our judgment was generally correct.

Now, in the report of so large a number of cases as Dr. Mayo presented this morning, we must reach the point of profound respect. He has brought to us a classification of his cases, the methods of operation and results, and we are all impressed with the honesty of his statements as to the kind of operation to do for this or that particular case, so that we must feel very grateful to him.

In my early operations I occasionally met with a vicious circle. I used the Murphy button for making the anastomosis between the jejunum and the stomach, and I felt, after the introduction of the loop, we had then reached a very perfect operation, and I had no reason to feel discouraged in the cases in which I have done that operation,

considering the results. But having seen Dr. Mayo operate, having seen the very delightful way in which he approaches the anatomical structures upon which he is to do this operation, I must say I feel we have made great progress, and that we are indebted to him for the steps many of us will follow out after reading his paper carefully, after studying his classification carefully, and particularly after we have seen him operate. In operating what impressed me was the gentle manner in which he approached the stomach and the intestines. There was no great exposure of the contents of the abdomen. These were points that I observed with great earnestness. I am sure in the use of the clamp he has advanced the operation, considering the way in which it is used and the very exceedingly neat manner in which the sutures are introduced. All these are points of great value; and yet others will do the operation, others will perfect it in some way or another. These improvements will go on, and we shall learn more in the future perhaps in regard to the technique, but I am satisfied that Dr. Mayo has given us this morning the results of his experience in such a way that we can rely upon them; that we are bound to respect this paper, and that it is going to do us great good.

We have had a most excellent meeting. We have had papers presented here which to me have been of great value. When I think of the subject of abdominal surgery, and the rapid progress that has been made in this department, I do not know that I have ever listened to a paper that has given me such profound gratification, and which, I am sure, is going to be a source of great comfort and of great benefit to our patients in the future. There are undoubtedly several Fellows here who saw the dreadful cases that came under the observation of the physician twenty years ago, cases of so-called dyspepsia, which were afforded very little or no relief by medicinal means; yet how great the difference to-day, and how pleasant it is to reflect that after such operations as have been described this class of patients soon gain fifteen or twenty-five pounds in weight, and enjoy their food, so that life is worth living. I recall patients with malignant disease of the stomach upon whom I have operated, who have been relieved, and their lives made comfortable for a number of months.

I feel personally thankful to Dr. Mayo for having had the privilege of listening to his excellent paper.

Dr. James E. Moore, of Minneapolis.

We often notice the evolution of an operation, and it generally comes to us through the experience of a large number of men. To-day we have had something which is almost anomalous in the history of surgery.

We have been given the whole evolution of surgery within the experience of one man. Dr. Mayo is a neighbor of mine. He used to come to me for pointers, and now I am pleased to reverse the order of things. I wish to thank him for the good he has done for suffering mankind, for the honor he has done for this Association. I wish to thank him personally for one particular thing, and that is the elimination of the loop. It has seemed to me always that there was a danger point in connection with these operations.

Dr. Robert F. Weir, of New York City.

I felt on listening to this paper a good deal like a chicken who sees a piece of meat or food of good size. You know how he acts. He grabs it, takes it in his beak, runs off to a corner, takes a bit of it off, then a little more and more, and finishes it off at his leisure. Such is the effect that this paper has had on me. We have had an immense amount of information given to us. I cannot take it all in and digest it at once. When several new methods are brought to our attention, it is not given to everyone of us to abort them all immediately. Individually I cannot do it.

There is one point, however, that stands out prominently and distinctly in this operation which has been evolved by Dr. Mayo and which is evident to us all, and that is shortening of the jejunal loop. Most of us practice gastroenterostomy in a little different way, for there are a great many ways of doing gastroenterostomy beyond those enumerated by Dr. Mayo, and this means that no one operation is as yet perfectly satisfactory. Not a single method has yet given such good results in a large majority of the cases as to satisfy the general profession that this or that procedure must be adopted. There is even a little of this same wavering in Dr. Mayo's admirable paper.

In speaking of the prominence of the short loop, of the methods of suturing, and of the use of the Murphy button, he alluded too briefly, for my own satisfaction, to the employment of the Mayo-Robson bone bobbin and of the McGraw ligature. As large as Dr. Mayo's experience has been in this work, we must all of us also consider the experience of others, as Moynihan and Robson, men who have had a very large experience with their methods and have reported admirable results. While from this I do not think the question of the operative method is entirely settled, I still lean toward Dr. Mayo's experience stronger than that of anyone else, since I know the man, for I have sized him up, as we all have, and I shall willingly follow his suggestions. But his gradual rejection of the Murphy button corresponds with a feeling that is within me, with my comparatively limited experience. We know its defects

as well as its advantages, and we are likewise a little shy, many of us, of the results that have been obtained in connection with the simple suture. The most important element in the Murphy button is that it furnishes a mechanical support which keeps patent the surgical opening in the stomach. If this support can be given, as I hope and believe it can be, by the Robson bone bobbin, or by the McGraw elastic ligature, or by the Maury method with twine (although my experience with the latter method is limited), I would prefer either of these three plans, which would be preferable to the simple suture method.

Dr. Charles A. Powers, of Denver.

I desire to emphasize the point that when doing a gastroenterostomy in the presence of advanced malignant disease the anterior operation is the best; it can be done in the simplest way and in the shortest possible space of time. These patients go down very rapidly, and it is essential that we should get in and out of the abdomen as quickly as possible.

Dr. George R. Fowler, of Brooklyn.

The large experience of Dr. Mayo and the entirely honest way in which he has presented it command our greatest admiration.

I have only a few thoughts to express. First, with regard to the importance of early operative intervention, even to the extent of a simple gastrotomy for the purpose of making a diagnosis in these cases. In one of Dr. Mayo's publications he calls attention to that matter in this way: He speaks of the necessity of first finding out exactly what it is necessary to do, and then, if it can be accomplished, doing it as rapidly as possible; if the condition of the patient or of the local disease is such that it cannot be accomplished, to close the abdomen as quickly as possible. This brings out the suggestion that success depends upon early operation, in the first place; and, second, success depends upon rapid operation.

As to the methods of rapid operation: while anterior gastroenterostomy may be a few seconds shorter in its accomplishment than the posterior method, I cannot see what is gained by it, or what it supplies to offset the great advantages to be derived from the posterior operation.

With regard to the McGraw ligature, and the use of the Murphy button, while we all agree that the Murphy button is admirably adapted to rapid operation, yet there are some disadvantages connected with its use, and among them the liability of contraction of the opening, which rather removes it from the available resources in these cases unless it is employed in carcinomatous or malignant disease, in which case it is

presumed the opening will be less likely to contract, and in any event will remain patent during the short time the case survives.

As to the method of anastomosis by the McGraw ligature, I have used it once, with failure to accomplish the purpose, as shown by the autopsy, although ample time had elapsed for this to have occurred.

Mention has not been made of the Maury string method, which I consider far superior to the McGraw ligature method, inasmuch as it eliminates the possibility of defective material and breaking of the ligature material, which does occur if great strain is put on the McGraw ligature. This has happened to me twice and has delayed operation. The Maury string method eliminates that factor. An enormous amount of pressure can be brought to bear on the constricted portions of the stomach and intestinal wall with this string, and practically with the certainty of producing the desired effect. I have followed the method of suturing with the Robson bobbin, but have omitted the bobbin in later operations, making the chain-stitch suture through the mucous membrane and serosa. No more sutures are actually applied than would be applied by the purse-string method, but the resulting puckering of the opening, when the sutures are drawn taut, is avoided by the chain-stitch. In this way it is not necessary to rely upon the bobbin, since the advantage of the latter is to prevent puckering of the mucous membrane and of the serosa when the line of suture is made taut.

With regard to feeding these patients, it has been said here that they can be fed inside of the fifth day. It is my habit in these cases to feed them at once, as if no suturing of the stomach was done. There is no objection to this, since drainage, if the posterior operation is done, is maintained in such a way that there is no objection to putting into the stomach milk and water or predigested milk. It has been my custom to feed these patients in some cases as soon as they have sufficiently recovered from the operation to swallow. In the number of instances in which I have done this I have had no occasion to regret it. It has been shown by experiments that the line of sutures in the serosa will bear hydrostatic pressure better on the first, second, and third days than it will on the fifth or sixth days. At the latter periods the suture itself becomes somewhat loosened by the subsidence of the swelling, while primarily and while the swelling is great the suture line is more to be depended upon than later on.

Dr. Robert F. Weir. I would like to ask Dr. Fowler about the Maury string suture, if it is not always on hand, or can be had at any time?

Dr. Fowler. It can be obtained at any time, like any ordinary string, and one does not have to rely on the manufacturer for its production or on the freshness of the ligature material.

With regard to the posterior method of gastroenterostomy, it continues to give me excellent results. I have operated upon patients in whose cases the skiagrams showed after two years the silver-wire suture still in position. The patients have suffered no inconvenience from the circumclusion of the afferent intestinal loop. Constriction as distinguished from circumclusion of the afferent loop at this point may produce sloughing. Care must be exercised in the application of the circumclusion loop of wire. The latter should never be drawn sufficiently tight to prevent the intestine from slipping easily through the wire loop. If care is not taken in this respect, I am persuaded that, on account of subsequent swelling and pressure at this point, it will be possible to have sloughing. All that is necessary is to approximate the mucous surface of the intestine itself. Further than that, no good is to be gained.

Dr. John C. Munro, of Boston.

I wish to acknowledge my everlasting gratitude to the Mayos for what they have taught me in stomach surgery. I do not believe, however, that the ideal operation for the average surgeon has been found. I think we are all influenced by our own experience, and though mine is small as compared with that of the Mayos, we are all trying to get at the facts with regard to these cases; so that what I wish to say is not a strong commendation of the short-loop operation. As our number of operations for benign ulcer amounts to about 130, this is perhaps too small an experience upon which to base facts or to draw reliable deductions. At the same time, as I have said, we are all influenced by our own results. We have tried the short-loop operation as carefully as we know how, and a large proportion of them have done well. The results have been as satisfactory as anything could be, but occasionally, and without any known reason, so far as we could tell, our method of operation not being changed a particle, a case gives us trouble with regurgitant vomiting. The patients do not starve. They do not vomit food, but they do vomit bile. Recently we ran a series of twenty cases done partly by the short-loop method, and partly by the modified Roux. All of our Roux operations have been absolutely perfect while the patients have been in the hospital, but the short-loop operations were not so satisfactory. We could not feed the latter patients so early, and a few of them had bilious vomiting from the first. We are patiently waiting, therefore, for the perfection of the short-loop method before

adopting it in preference to the modified Roux. The reason for this is that our technique is defective, but where it is defective I do not know. I think we all want to get at the facts in these cases, and while I do not want to throw cold water on any method, I feel we ought to give our personal experience.

We all owe a debt of gratitude to the Mayos for their gastrectomy operation. This operation, as they have perfected it, has robbed that procedure of almost all of its terrors, and the results are, I think, almost phenomenal.

Dr. Dudley Tait, of San Francisco (by invitation).

It is certainly with misgivings that I dare to address such a distinguished audience. Living on the coast here, in what we call a side-tracked city, and not having the facilities and great opportunities that the Fellows of this Association have in the East, we have become very humble in our aspirations, and you may know or have seen that the work here is so divided that none of us can have a very large surgical experience. Hence our thanks for the experience that you bring to us on this occasion.

Like many others, I have journeyed to Rochester (Minnesota), to that great surgical shrine where dominate two masters, and on each occasion of my pilgrimage to that shrine I have come away bewildered with a knowledge of what I saw there. I have carried that knowledge to my masters in Europe, and they shared my enthusiasm for the work done at Rochester.

Aside from my clinical work in gastroenterostomy I have viewed the question from the standpoint of experimentation, taking up in particular the elastic-ligature method. The results of this work are to be published in an article in the *Annals of Surgery* very soon, and would seem to prove, first of all, that from an historical point of view every vestige of priority can be removed from the distinguished surgeon (Dr. McGraw), after whom the ligature operation has been named. We have demonstrable evidence that this method was practised early by Italian surgeons, who discarded it, and later on it was taken up by the Germans. From the standpoint of experimentation we have also shown that in comparison with other methods the suture, the so-called Connell suture, the Murphy button, the Mayo-Robson bobbin method, the elastic ligature makes a more perfect aperture than any other method. It can be easily recognized upon the specimen. It is large, clean cut, and has a sharp regular edge. While the classic-suture method produces a more irregularly shaped orifice, experiments show that all intestinal openings eventually become circular or oval. The stoma made by the Connell

method is the smallest and the most liable to subsequent contraction. The so-called Maury stitch is an old discarded Russian procedure. Comparative experiments show that this stitch is complicated, bloody, dangerous, producing marked kinking and no larger openings than those made with rubber in the usual manner. Twine has failed to cut out. We observed dogs for a year and a half, and failed to note any contraction of the stoma made with the elastic ligature.

Of course the pathological side cannot be discussed in a meeting of this kind; these details must be taken up separately. I beg, therefore, to be excused from going further into the experimental side, and thank you most heartily for the honor of appearing before you.

Dr. Mayo. I wish to thank the gentlemen for their very kind discussion. They have given me more credit than I deserve. I am very glad that Dr. Weir and Dr. Munro brought up the point that we are still in the experimental stage as to the best method of operation. I claim no priority or originality whatever for the procedure which I have brought before you to-day, and in my paper I name it the Moynihan-Peterson method, because to these two gentlemen, more than any other, belongs the credit for the various principles which I believe to be involved in this operation. All of the various plans which we have adopted, without exception, have furnished a certain percentage of secondary operations; that is to say, there has been a change from one method to another, because each one with which we became acquainted had certain inherent disadvantages. This is so true that in the two or three months which would elapse between the reading and the printing of almost every paper on this subject which I have had the honor of presenting to medical societies, we have changed the particular method that was under review at the time. The same may be true of *this* operation. I have given the dates of the changes in the various operative procedures in order to show that the operation we are doing now is comparatively recent, which at once demonstrates that the number of cases is insufficient to establish it as being *the* method of operation. But there are certain principles gradually being established that go to show that the operation without a loop must be the method of the future, whether by the technique we are using now or not. It has already given us better results up to this time than the other methods which we have used. But whether this particular technique will stand the test of time or not I do not know.

We must consider that functionally the small intestine begins, not at the pylorus, but at the common duct, four inches below the pylorus, and that the food does not enter at the common duct, but four inches

above it. The duodenum is ten inches long and we are able by this operation to get food into the jejunum within eight inches of the common duct. Eventually I feel sure we will eliminate any operation which throws out of commission so valuable a portion of the upper intestinal tract as must be done in any of the loop operations. The next point to be considered is that while the Roux operation gives excellent results, it is not an operation which can be done in less than thirty-five to fifty minutes, including opening and closing the abdomen. As compared with the ordinary suture operation, we have nearly three times as much work to do in the Roux or any of its modifications as in a simple gastroenterostomy. The Roux operation is one which can be safely practised by comparatively few men. Take a surgeon like Dr. Munro, with his large experience in abdominal work, he can do the Roux operation safely; whereas in the small experience of many men the complicated character of the procedure would prevent them from giving the necessary relief to their patients. For the average case where disability rather than impending death is the incentive to operation we must have a simple, safe operation which can be performed by the average surgeon. I hope we will develop a better operation than the one I have described, but so far as we have gone it is the best method we have used.

I tried to bring out one thing in my paper, and that was the increasing betterment of the statistics of operative work upon the stomach. I had an object in doing this. When we consider that cancer of the stomach, as shown by statistics, comprises no less than 30 per cent. of all the cases of cancer in the human body (Welch puts it at 24 per cent.; Virchow, 30 per cent.; Haberlin, 41 per cent.), it becomes necessarily one of the most important subjects before the medical profession to-day.

Why has the surgical relief of cancer of the stomach been so backward? For two reasons—first, because of statistics showing the enormous fatality which attended the operations made in the beginning of gastric surgery. This has prevented the normal evolution of the subject, and has deterred surgeons from operating upon the cases. The next thing has been the question of diagnosis. Not a great while ago I went through the medical wards of one of the great hospitals of this country with one of the greatest teachers we have ever produced, an internist. He showed me ten cases of cancer of the stomach. I said to him: "Doctor, do you admit cases of cancer of the lip and of the breast into the medical wards?" He said he did not. Now I do not think a medical man has any more business to have a case of cancer of the stomach in his ward than he has to have a case of cancer of the lip, for the reason that cancer of the stomach is not a medical disease—it is purely surgical. If we can establish the fact that operations upon the stomach are

relatively safe, we will have done the first thing necessary to get cases of cancer of the stomach to operate upon. (Applause.) We should strive to educate medical men to recognize that cases of cancer of the stomach are surgical from their inception. When they look upon a case of supposed cancer of the stomach as one of possible ulcer, they are reluctant to have the patient operated upon. Medical men must be educated to the point of knowing that a certain percentage of cases of ulcer of the stomach are within the province of the surgeon. When the medical man suspects cancer of the stomach he should see to it that the case is referred to the surgeon at the earliest possible moment. It is this one thing we need. We have confidence in our surgical methods, and our technique is such that we can now more than compete with the internist in cases of uncured chronic ulcer of the stomach, but we need to establish that degree of confidence which will induce the general practitioner to turn over not only his uncured cases of ulcer of the stomach, but cases of *suspected* cancer, so that we can get at this one part of the body in which cancer has not yet been thoroughly attacked.

# INTUSSUSCEPTION: REMARKS UPON THE SURGICAL TREATMENT, WITH THE REPORT OF A CASE OF SPONTANEOUS REDUCTION AFTER TEMPORARY ENTEROSTOMY.

By MAURICE H. RICHARDSON, M.D.,

AND

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Spontaneous reduction of an intussusception is undoubtedly rare. Some writers have maintained that slight temporary intussusceptions are more common than is generally supposed, but there is little evidence in support of this view. Certainly the typical cases in which the diagnosis can be made clinically seldom end in this way. Whether or not many attacks of colic in children are owing to slight intussusception cannot be proved. But spontaneous reduction in a case which shows the typical symptoms and signs of the so-called "inflammatory" intussusception—pain, fecal vomiting, distention, currant-jelly stools, and tumor—is rare indeed.

By *spontaneous reduction* is meant only the unfolding of the bowel into the original form of a single tube. This does not include that form of natural cure which takes place by gangrene and sloughing of the intussusceptum. Instances of this process are comparatively common.

In the following case it seems impossible that a mistake in diagnosis could have been made, for the small intestine was firmly invaginated into the large, as was demonstrated to the entire satisfaction of many members of the staff of the Massachusetts General Hospital and of a large audience. The case, in brief, was an invagination of the small intestine into the large; failure

of reduction by very moderate traction; enterostomy; recovery from operation; death from pulmonary complications; and painstaking autopsy, at which no signs of present or previous intussusception could be discovered. It seems to me almost incredible that the condition present at operation could have left practically no signs preceptible at autopsy. That there was an extensive invagination of the small intestine into the large—an apparently hopeless wedging of the one into the other—admits of no doubt whatsoever. An abstract of the case, taken from the Massachusetts General Hospital Records (Hospital No. 141,487; Autopsy No. 1333), is as follows:

Charles S., aged four years, was taken with vomiting and pain on February 16, 1905. From that time until his admission to the Massachusetts General Hospital, at noon on February 25th, the boy had vomited and cried. There had been small movements of the bowels during this time. The patient was well developed and well nourished, but looked very sick. The respiration was 35; the pulse 124; the temperature 100°. The leukocytes numbered 6000; the heart and lungs were normal; the abdomen was everywhere distended and tympanitic. Through the thin abdominal walls, intestinal peristalsis, coming on in intermittent spasms, was distinctly visible. In the left side of the abdomen a resistant, sausage-shaped mass was easily palpable. Nothing else abnormal could be felt in the abdomen. A small amount of liquid fecal matter was found in the rectum. There was constant regurgitation of black fluid, apparently fecal. The diagnosis of intussusception was made and the child prepared immediately for operation.

The general condition was so bad that the immediate prognosis was grave. In view of the long duration of symptoms and of the evident intestinal obstruction it seemed unwise to try reduction by hydraulic pressure or by other non-operative measures.

Under ether the tumor of the intussuscipiens and the intussusceptum could be unmistakably felt. Neither the history nor the physical examination gave ground for the least doubt as to the diagnosis. The condition had lasted so many days that reduction of the invagination did not seem possible, even if more force were used than is usually regarded as advisable when the vitality of the gut is questioned. In previous operations I had seen serious if not irreparable injury follow these attempts, and I was determined

that in the present case the success of the operation should not be jeopardized in this way. Not only in intussusception but in a great many strangulated hernias I had seen unfortunate results from too forcible taxis. In the latter cases I had learned to content myself with the gentlest manipulations. So in the present case I had planned before opening the abdomen not to make any but the most careful efforts at reduction.

My first error in this case was in not trying the effect of moderate hydraulic pressure through the rectum; the second was in not making greater efforts to reduce the invagination after the abdomen had been opened.

The child was so small that the abdomen could be almost entirely covered by my hand. A median incision showed at once the correctness of the diagnosis; the small intestine had been extensively telescoped into the large. The constricting ring of entrance was in the left upper quadrant; the tip of the intussusceptum at the left pelvic brim. The descending colon was about the size of the wrist. Into the constricting ring of the intussuscipiens the mesentery of the small intestine was so tightly drawn that the tense band characteristic of the lesion was conspicuous to sight and perceptible to touch.

The peritoneum of the colon (intussuscipiens) was unchanged. It was smooth, glossy, and without that tense and cracked appearance which I had seen in previous cases. There were no adhesions between the opposing peritoneal surfaces of the intussuscipiens and the intussusceptum. Gentle traction on the small intestine permitted the escape of a small portion of the small intestine, with relaxation of its mesentery. The method by which traction upon the small intestine is exerted with one hand, while with the other the mass is "milked" back, was not tried. In view of the subsequent events I am sure that I did not give the child the best chance to recover. I was, as I say, prejudiced against the possibility of reduction, having hitherto failed to accomplish it.

The correctness of the diagnosis was, as I have said, evident immediately upon opening the peritoneal cavity. A little free fluid, a tense edge of mesentery, a small intestine disappearing into the large, a sausage-shaped tumor in the large intestine extending as far as the pelvic brim, made the condition unmistakable. The amount of intestine invaginated was estimated to be at least twelve

inches, for the mass extended from the left upper quadrant to the left pelvic brim.

The child did badly under ether; indeed, it seemed at one time as if death were impending. It was evident that that procedure was indicated which would give relief in the quickest, if not the most effective way. Efforts at traction, resection of the intestine, and all other time-taking operations were abandoned for the simple and rapid though temporary relief of an enterostomy. A loop of intestine was therefore drawn from the peritoneal cavity and held in position by means of a pair of hæmostatic forceps thrust through the mesentery, while the rest of the incision was closed.

This procedure appeared, upon careful consideration afterward, a sensible means of giving not only temporary relief but permanent cure by permitting the invaginated gut to become gangrenous and exfoliated by the rectum. I regretted that I did not sew the small intestine to the large at the constricting ring; for the operation, with the relief afforded by the enterostomy, would ensure, it seemed, a cure not only certain but safe. It seemed reasonable enough to conclude that the opposing peritoneal surfaces would adhere to each other and that the gangrenous loop would become separated and expelled.

The child was put to bed alive, but in a very feeble condition. In the course of a few hours there escaped from the wound a small loop of intestine which required reduction and suturing. The bowel was then opened. The enterostomy soon became well established. The child, however, though taking nourishment well, gradually lost strength. A purulent bronchitis developed, with respirations gradually increasing from 35 to 70. Death took place on March 16th, twenty-eight days after the initial symptoms and nineteen days after the operation.

At the autopsy a purulent bronchitis was found, with a fibrino-purulent peritonitis. Not only was there no trace of the intussusception to be found, but no evidence whatever appeared to show that there had ever been an intussusception. Dr. Oscar Richardson was unable to make out the seat of the invagination, the position of the constricting ring, local changes in the peritoneum, or any other indications of the lesion which had undoubtedly existed. Had there been the least doubt of the existence of an intussuscep-

tion we should all have said that from the abdominal condition found at the autopsy no intussusception could have possibly been present.

I had always been opposed to the medical treatment of this lesion, because I had seen the evil effects of injection. Moreover, in the few cases that I had operated upon it was impossible mechanically to reduce the invagination. Intussusception is, however, a very unusual disease. No one man can see much of it. The present case shows the folly of drawing positive conclusions from one's own necessarily limited experience.

I have felt since the findings of the autopsy that in this case medical treatment might have succeeded, for there was nothing to be overcome except the contractions of the large intestine, which alone held the intussusceptum; that with a little more patience under gentle manipulations the invaginated bowel might have been reduced. I was, however, satisfied with my efforts, for there was every reason to think that the circulation had already been cut off, and that the opposing layers of congested peritoneum were hopelessly adherent. Moreover, the rapid fastening of a coil near the point of telescoping made it possible to get the child to bed alive; and, furthermore, it gave nature a chance for spontaneous sloughing and discharge of the invaginated coil. I expected fully that a natural cure would be effected by sloughing and discharge of the sphacelated small intestine. The possibility of a retrogression—of a regurgitation, so to speak, of the telescoped coil—never occurred to me. The influence of distended coils of small intestine, forcing ahead in violent muscular paroxysms the intussusceptum, was apparently great—so great, indeed, that I would have regarded, as I did regard, mechanical reduction as impossible.

That the letting up of muscular spasm due to a temporary enterostomy should permit a spontaneous disgorgement of the intussusceptum seems an extraordinary occurrence, and one well worthy of being put on record. The lesson which I have learned in this and a few other cases is that intussusception is a lesion about which we really know but little; that medical or palliative measures should be considered in the very beginning, and then only when the symptoms are mild and the patient's strength good; that surgical rather than medical treatment should be employed when

the diagnosis is sure, after the failure of brief and gentle palliative measures; that a case must not be regarded as hopelessly involved because it has been of several days' duration; and finally that, because one case has become spontaneously reduced, we should not conclude that spontaneous reduction is likely therefore frequently to occur.

And yet the experience gained in this case, in view of the results in every other case which I have seen, hardly justified departure from the usual methods advocated in the treatment of this formidable and fatal affection. The possibility of a spontaneous reduction, as Dr. Palfrey has shown by a thorough search through the literature, is so questionable that the case seems the only one in which disinvagination cannot be denied. Were the case to be taken as a justification for prolonged and forcible efforts at reduction by so-called medical treatment much harm would surely result. The experience at the Massachusetts General Hospital has shown that only the most radical surgical operations are efficient —disinvagination by taxis, intestinal resections, enterostomies—and that even these measures have failed in most cases, because they have been the last rather than the first resort.

This case should lead us to assume that in all acute abdominal emergencies the gravest rather than the mildest danger threatens; that the most rather than the least effective methods should in the first instance be selected, even if there be greater danger in the application of the former. As the case herewith reported shows, the danger of the radical operation, with its attending complications—immediate and postoperative, exceeded necessarily in the long run the dangers which would have attended an immediate and effective exploration. The best results and the lowest mortality in intussusception will follow those measures which, undertaken at the earliest possible moment, cannot fail to remedy completely and effectively the evil.—M. H. R.

Of the few cases of true disinvagination that have been reported a large proportion are far from conclusive. So frequent and so uncertain are they that in a majority of the text-books of surgery, and also in many exhaustive articles upon intussusception, it is not stated that spontaneous disinvagination is possible.

Yet there is in literature a considerable mass of evidence that

invaginated bowel may at times return to its normal condition without external assistance. Leichtenstern[1] thought it firmly established that intestinal invaginations may be reduced spontaneously; but writing as he did (in 1876) before laparotomies were common, he cited cases in which the diagnosis was made on clinical evidence only.

Treves,[2] in his work on intestinal obstruction (in 1884) says: "There can be little doubt of the existence of this method of cure, although its occurrence must be of extreme rarity." He refers to 2 cases, reported in 1812 and in 1865, respectively, also to 1 more recent case, in which, after the clinical diagnosis of intussusception had been made, autopsies showed no abnormality except that a portion of the intestine was shrunken and congested. In 2 other cases with symptoms suggesting intussusception spontaneous recovery occurred without mention of discharge of slough; but in these, as Treves points out, simple fecal impaction cannot be excluded.

Fitz,[3] in 1888, mentions the experiments of Senn[4] and the case of Langmaid.[5] Langmaid's case is as clearly defined as is possible from clinical evidence alone, but lacks the final confirmation of operation or autopsy. The experiments of Senn show conclusively that artificial invagination in cats possesses a strong tendency to spontaneous reduction. Senn, however, has also expressed the opinion that infants and young children seldom if ever recover in this way.[6]

More recently a number of cases have been reported, all having considerable weight, but each establishing merely a strong presumption rather than absolute proof.

D'Arcy Power[7] reports a case in his service at St. Bartholomew's Hospital. The patient, a boy aged six months, presented on entrance to the hospital a typical picture of intussusception. Operation was performed at once, two and a half days after the onset of symptoms. No intussusception was found, but a portion of intestine three inches in length was intensely congested and covered with flakes of lymph. Above this area the intestine was constricted and the peritoneal covering abraded. From these findings and from his experience with the conditions present in intussusceptions, Power is confident that an intussusception had been present and was spontaneously reduced. He mentions the case

of Turner as the only similar one within his knowledge. This from such an authority upon intussusception as Power shows the rarity of spontaneous reductions.

Turner's[8] patient was a boy, aged three and a half years, who showed typical symptoms of intussusception, with a tumor in the right iliac fossa. At operation performed on the sixth day of illness no intussusception was found; but the lower three or four inches of the ileum were reddened and the thin peritoneal coat roughened. Glands in the corresponding part of the mesentery were enlarged. After operation recovery was interrupted.

Underhill[9] reports a case in which the diagnosis of intussusception seems unquestionable. The tip of the intussusceptum could be plainly felt within the lumen of the rectum. The condition of the child was so bad that no operation was performed; yet the tumor gradually disappeared and recovery followed. No evidences of sloughing or gangrene are mentioned.

Tuttle[10] describes a case in which the patient, when first seen, had pain, vomiting, bloody stools, and tumor. After transportation to the hospital and anæsthesia no tumor could be felt. Recovery followed.

Johnson[11] reports a similar case in which the tumor was much smaller under anæsthesia than when first felt. At operation a small reducible intussusception was found.

Nothnagel[12] reports a remarkable case which is much quoted by other authors. The patient, a man aged fifty years, in April, 1892, began to have attacks of pain and vomiting. The diagnosis was neoplasm of the intestine. Operation was advised, but refused. In June, 1892, after admission to the hospital sudden and complete recovery occurred. In November, 1893, the original symptoms recurred, and in addition a tumor developed. In April, 1894, the abdomen was opened and there was found an intussusception, without adhesions and easily reducible. At the tip of the intussusceptum was a polyp. The inference is that in the spring of 1892 also there had been an intussusception, ending by spontaneous disinvagination.

Meyer[13] reports a case of intussusception in a boy, aged nine and a half years. Laparotomy on the eighth day of symptoms revealed an extensive ileocolic invagination. After efforts at manual reduction had failed an ileostomy was performed as a palliative meas-

ure. From the time of operation vomiting and pain ceased. Three days later gas and feces were passed by rectum. Three weeks after operation the fecal fistula was closed. The tumor disappeared and the child recovered completely.

As has been said before, however, there is some weak point in the chain of argument in each of these cases. Even in the case of Meyer the question may be raised whether gangrene and sloughing of the intussusceptum did not occur undiscovered.—F. W. P.

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## DISCUSSION.

Dr. John Collins Warren, of Boston.

I have had a limited experience in operating for reduction in cases of intussusception. I have had four cases in which laparotomy was performed, three of which terminated satisfactorily, and one in which death occurred. In one of them I found reduction very difficult, it being one of the successful cases, in which there was a sloughing loop of bowel, afterward an intestinal fistula, and finally suture of the intestine, with recovery. I have always thought it very important to be very gentle in making movements of taxis and to use as little traction as possible, but rather push the intussusception out than to draw it out. I think Dr. Richardson's experience in regard to this is to continue any efforts at taxis, even though the case may have gone for as many days as it did in the case which he has reported, because it is certainly very encouraging to think that the vitality of a large loop of intestine may be preserved eight or nine days under conditions which may seem impossible to carry out reduction.

I have not tried any of the plastic operations which have been described.

He has given us a valuable contribution to the question of operative intervention in cases of intussusception.

I agree with him in thinking that pressure by water should be tried in a certain number of cases. If I were called to a well-advanced case I should prefer to take the chance of incision through the abdomen and taxis rather than the risk of some trouble being produced by water pressure.

Dr. Dudley P. Allen, of Cleveland.

It seems to me that an important factor in these cases of intussusception is early operation, and in making a positive diagnosis otherwise impossible I have been materially assisted by administering an anæsthetic to the child. This relaxes the abdomen and diagnosis becomes easy.

Dr. John C. Munro, of Boston.

Inasmuch as spontaneous reduction in cases of intussusception is so rare, I wish to report a case in a young girl in whom there was a typical intussusception of the lower bowel, plainly felt by rectum.

She was very ill, but an immediate laparotomy was done, and when we entered the abdomen we found that the intussusception had resolved spontaneously. The child died within forty-eight hours, but we were able to obtain the lower bowel and rectum, which pathologically showed characteristic evidences of an intussusception that had previously existed.

Dr. George R. Fowler, of Brooklyn.

I have been very much interested in the report of Dr. Richardson's case of intussusception. It is an extraordinary fact, well worthy of comment, that intussusceptions have been spontaneously reduced after the lapse of nine days. It is not at all improbable that early intussusception, the result of erratic peristalsis occurring in the course of attacks of colic from which children suffer, may be and is frequently reduced. I myself opened an abdomen for intussusception that had been in existence forty-eight hours, and found five points of intussusception altogether, the first being considerably adherent, while the others were recent; one of these became spontaneously reduced in the course of manipulation necessary for the reduction of the older one. The evidence offered by Dr. Richardson in this case is of the most convincing character.

Dr. Robert F. Weir, of New York City.

There was a point slightly alluded to by Dr. Munro which I wish to speak of, and that is the advantage of bimanual exploration in the young infant. I have tried this in several instances, introducing my finger into the rectum of the child, under two years of age, and have been able to detect a tumor or intussusception in the abdominal cavity up to a little above the region of the umbilicus. You can sweep the finger entirely over and feel any mass there, and in two instances I detected a strangulated hernia which had recently entered the inguinal canal and which was reduced by the traction of the intra-abdominal finger; in another instance in an obscure case of appendicitis, where no tumor could be felt, per rectum, it was easily recognized. I speak of the advantage of this in young children and of the possibility of introducing a fairly large index finger and of reaching so high up as to be able to get a clue to the trouble which may otherwise escape observation, this being done under an anæsthetic, of course.

Dr. W. L. Rodman, of Philadelphia.

It seems to me the encouraging point in connection with Dr. Richardson's case is that we ought to operate upon these cases, even though they seem to be *in extremis*, inasmuch as a simple enterostomy may

afford relief. Many of us have been deterred from operating such cases in the past, because we have thought they would not stand the additional shock of an intestinal anastomosis or resection of the gut. If they can be relieved by a simple enterostomy, which can be quickly done, we ought to give them the benefit of the doubt, and in that respect the report of the case of Dr. Richardson is most encouraging.

Dr. George Ben Johnston, of Richmond.

I should like to speak on Dr. Richardson's case, not that I have had a similar one, but to lay stress on what has been said in reference to digital examination for the diagnosis of intussusception. I believe that when a very young child of small stature is anæsthetized, by introducing one finger into the rectum, with the other hand over the abdomen, intussusception may be often readily made out. I have in at least four instances made a diagnosis of intussusception in the early stages by this method, and in every instance operation has succeeded in relieving the child. In one case I relieved an intussusception by operation and taxis which had existed for twelve days. In another case a physician brought a child to me, suffering from what he thought a prolapse of the rectum. Examination revealed the fact that the child had a large mass of bowel protruding from the anus, and this presented all the characteristics of an intussusception. The condition began twenty-one days before the child was brought to the hospital, and the doctor described it as a dysentery. I opened the abdomen in this case and found five distinct intussusceptions, and succeeded in satisfactorily reducing them. Recovery was prompt. Such an experience should be encouraging to us and proves that even desperate cases are not always hopeless. If we cannot succeed by gentle methods in reducing the intussusception, after the abdomen is opened, we can do what Dr. Richardson did, and hope nature will perform the remainder of the cure. I have no doubt that a great many cases of intussusception are overlooked. If diagnosticated early and operated promptly the results are excellent.

Dr. Richardson. The discussion reminds me of a previous one at Albany, where Dr. Coley reported the cure of an enormous inoperable sarcoma of the abdominal wall. The only criticism made on Dr. Coley's case was that he must have been mistaken in the diagnosis. The opinion of Dr. Garland (the attending physician), my own opinion, and the report of the microscopist (Dr. Whitney) all agreed that the tumor was malignant—an inoperable sarcoma. This evidence was not, however, deemed sufficient by some members of the Association,

who thought the fact that the patient was cured sufficed to prove that sarcoma could not have existed.

In presenting, therefore, a history which to me, who observed the patient from beginning to end, seems incredible, I am reminded of the doubts thrown upon Coley's case just mentioned; and it seems imperative to present a chain of facts which the most ingenious critic cannot succeed in breaking.

Several members of this Association were present at the operation in my case, and they saw the exact condition of things. There can be no doubt that this was an intussusception. The only source of error would be that of confusing it with the well-known intussusception occurring multiple in children in the so-called agony of death. I have seen several of these at autopsy. They are in the small intestine and multiple; the invagination does not exceed an inch, and does not concern in any way the progress of the disease—whatever it may be. In an epidemic of cholera infantum at the State Hospital in Tewksbury one or more of the children died. At autopsy multiple intussusceptions were found. It was thought by the hospital staff that in the other children similar conditions might exist; and that they, of course, demanded operation. It seemed to me that if similar conditions existed, they had no bearing on the course of the disease; that they were physiological curiosities rather than actual lesions. They are, in fact, entirely different from the single, irreducible, and fatal intussusceptions at the ileocæcal valve.

# PERFORATION OF THE GALL-BLADDER:

## WITH A REPORT OF TEN CASES.

By ARCHIBALD MacLAREN, M.D.,
ST. PAUL, MINN.

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Gall-bladder perforations are comparatively rare, especially if we confine our observations to ruptures due to violence, ulceration, and gangrenous inflammations. But if we add to these the cases of cholecystitis in which inflammatory products have evidently escaped from or passed through the wall of an inflamed gall-bladder, even though we may not find the perforation itself, the number of cases is considerably increased. When an abscess forms about an inflamed appendix we speak of it as due to a perforation of the appendix. Such abscesses about the gall-bladder, either in the free peritoneal cavity or in the neighboring liver tissues, are rare as compared with appendiceal abscesses, but are not uncommon and unquestionably should be included when studying perforations of the gall-bladder.

Fistulous passages between the gall-bladder and duodenum, stomach or colon are, of course, due to perforation of the gall-bladder and usually to the ulceration through the visceral walls of a large gallstone. Large-sized stones always pass in this way instead of through the ampulla (Mayo).

Most perforations of the gall-bladder occur in neglected cases where gallstones have been known to exist for long periods of time and where the patient has had ample warning through many attacks of biliary colic. In such a patient a secondary cholecystitis or an attack of typhoid fever brings the added risk of perforation of the gall-bladder, producing either septic peritonitis or a localized abscess.

It seems worth while to study this subject for a few moments and try to arrive at some conclusion regarding the frequency of this accident. Because even such a personally deluded medical fanatic as J. H. Keay, in his recent book on the medical treatment of gallstones, admits that most cases of perforation of the gall-bladder ought to be operated upon.

In the medical literature of to-day we find a few reports of single perforation cases, and Drs. Erdmann and Keen, in the *Annals of Surgery* some two years ago, collected 34 cases of primary typhoidal perforations. Of this number 7 were operated upon, with 4 recoveries. Of the 27 not operated upon, all died.

We may approximate the percentage of perforative cases by a careful study of Robson's 539 operations on the gall-bladder and bile-ducts published in December, 1903. In the text he only speaks of 5 perforative cases, but if we carefully read the detailed histories of all of his reported cases we will find that 25 of these cases can be fairly said to be perforative in character, or a percentage of 0.046 per cent. In his first 270 cases only 7 are of this character, while in the last 270, 18, or 0.066 per cent. Of this number there are 3 cases of general peritonitis due to rupture of the gall-bladder; 10 intraperitoneal abscesses, most of them containing gallstones and usually situated between the gall-bladder and the duodenum; 1 in the head of the pancreas, containing a single gallstone; 7 abscesses of the liver close to or opening into the gall-bladder, several of which contained gallstones; 4 fistulæ, 3 between the gall-bladder and the duodenum, and 1 between the gall-bladder and colon. And there was 1 case where a gallstone was found one-half in and one-half outside of the gall-bladder, still plugging the opening. Of these 25 cases there were 5 deaths, or a mortality of 25 per cent.

The Drs. W. J. and C. H. Mayo, in 328 cases operated upon between June, 1901, and February, 1902, at St. Mary's Hospital, found 13 cases where gallstones were lying in pockets outside of the gall-bladder. There were 2 subcutaneous abscesses containing gallstones and 1 case in which such an abscess had ruptured, leaving a fistula discharging pus and gallstones. A total of 16 cases.

Dr. A. J. Ochsner in the 48 cases operated upon at the Augustine Hospital in 1901 had one perforation; fourteen gallstones were found in an abscess in the anterior abdominal wall. Single perforative cases from gangrene of the gall-bladder are reported by Hotchkiss, Mayo, Robson, and Gibbon.

Rupture of the gall-bladder from violence is rare, especially if in its normal state; Dr. John F. Thompson's and Dr. DeForest Willard's cases stand practically alone in this class. In the latter the child was crushed by a wagon wheel and two months later Dr. Willard found sixty-four ounces of encapsulated fluid, which was almost all pure bile.

Case I.—The first case of perforation of the gall-bladder that I ever saw was due to direct violence exerted upon an enlarged diseased gall-bladder. Major W. was a Civil War veteran, aged sixty years. He was supposed to have suffered from chronic malaria, for which trouble he was sent to Minnesota some twenty years ago. For many years he was a patient of Dr. Wm. Pepper, of Philadelphia, and he had seen all of the leading medical men of the East with periodic enlargements of the "liver," which was never associated with marked colic or jaundice. I knew him as a friend and neighbor for many years, during at least ten years of his later life, when he was never seriously ill. As a result of a gunshot injury received in the service, he wore a wooden arm. Tripping one day on the street he fell forward with his arm bent under him, so that the wooden fingers of the artificial arm pressed directly on his enlarged gall-bladder and caused it to rupture. I saw him forty-eight hours later in consultation, when an operation would have been of no avail. Later I made a postmortem examination and found a general septic peritonitis due to a perforation of a gall-bladder at least six inches in diameter with very thick walls. The rent in the anterior wall of the gall-bladder would admit my finger. The gall-bladder contained over fifty large-sized old black stones and thirty-two ounces of thick pus; pus was also present in the peritoneal cavity.

Case II.—Mrs. S., aged thirty-five years; seen with Dr. Beal, of West St. Paul; never had suffered from typhoid or jaundice;

colic every other night for past two weeks, with evidence of upper peritonitis of a subacute character. Operation November 30, 1899; universal adhesions, a small, thick gall-bladder containing six medium-sized gallstones. A hard nodule in the under surface of the liver was opened and found to contain a single gallstone of the same size, color, and shape of the other six. This cavity and the gall-bladder was drained and the woman promptly recovered.

CASE III.—Dr. DeW., aged fifty years, U. S. A. First attack of colic fourteen years ago. One year before I saw him, while serving in the army in Cuba, he broke down and was invalided home with a return of his attacks of colic. He first became aware of the existence of a tumor in the gall-bladder four weeks before consulting me. Just as all preparations had been made for an operation the tumor suddenly disappeared and the patient felt better. Later he commenced to suffer with night pains, pleuritic in character in the gall-bladder region, and ten days later the operation was performed. A small abscess between the colon and the perforated gall-bladder was found. There were no gallstones either in the biliary passages or in the abscess, but a perforation as large as a lead-pencil was found on the anterior wall of the thickened gall-bladder. The gall-bladder was drained; it should have been removed, for a mucous fistula still exists, and the Colonel is perfectly comfortable while it discharges, but very uncomfortable when it attempts to close.

CASE IV.—Mrs. J., seen with Dr. Jones, of Battle Lake, Minn. Patient was thirty-five years of age; had been sick and suffering with right hypochondriac pains for three weeks past. Universal adhesions were found binding the thickened, inflamed gall-bladder to the pylorus, duodenum, and colon. One large-sized gallstone was found wedged into the cystic duct; the gall-bladder was filled with a thick, muddy, serous fluid. Under the gall-bladder was a small puddle of the same thick fluid, although no perforation could be found. Mrs. J. promptly recovered after drainage of the gall-bladder and was well when last heard from, eighteen months after the operation.

Case V.—Mr. A., was almost a full-blooded Indian, living in the Indian Territory. Taken sick while travelling through the Northwest. He had been sick for three weeks with a hard, painful tumor just below the edge of the ribs on the right side. He had a constant temperature of about 101° and was slightly jaundiced.

At operation he was found to be suffering from gangrene of the gall-bladder and quadrate lobe. Drainage of the abscess with a tube was unsatisfactory and he refused to be operated upon the second time. This patient died from sepsis eight days after the operation. Postmortem by Dr. Cameron; no gallstones, but extensive gangrene of the gall-bladder and neighboring liver tissue.

Case VI.—Mrs. C.; sent by Dr. Chas. Germo, Balaton, Minn.; aged sixty-one years; thirty years ago had suffered for three or four years with biliary colic, the attacks coming every few months and frequently lasting two or three hours. After this time she had no abdominal distress for twenty years. Of late there had been a return of her old trouble, which was now more constant and more intense in character. She was jaundiced, with clay-colored stools, frequent chills, and irregular temperature. At the operation the small, contracted gall-bladder was found densely adherent to everything, especially to the duodenum, which showed a well-marked scar of an old perforation. Three stones were found in the common duct. Cholecystectomy and choledochotomy were followed by recovery, and seven months later she reports herself cured.

Case VII.—Mr. B., aged twenty-five years; patient of Dr. Ramsey, of St. Paul. Last September I operated upon this young man for relapsing appendicitis during the interval and removed a seven-inch appendix showing subacute inflammatory changes. Three days after the operation he developed a right lobar pneumonia, which resolved on the eighth day. He was perfectly well for two months, when he had an attack of cholecystitis; soon after he had an attack of obstruction with marked impaction in the transverse colon, relieved on the tenth day. From this he quickly recovered and was well enough to be married. About two months

after his marriage he had a second attack of cholecystitis with persistent vomiting of bile. All nourishment was stopped by mouth, but still his vomiting continued; three or four times each day he vomited about six ounces of a deeply green fluid. Operation was postponed because of his good general appearance and of his strong, regular pulse, which ranged about 80.

After he had been nourished and watered through the rectum for a month, and was not able to retain even water, I operated upon him and found a contracted gall-bladder adherent to all of the surrounding tissue, but no stones. A broad band of adhesions ran from the gall-bladder region down across both the duodenum and the transverse colon, markedly constricting them both. This was divided and the gall-bladder was then removed. In removing the gall-bladder I opened into an abscess of the liver, which contained three ounces of thick, brownish pus just at the commencement of the cystic duct. Thinking that I had found the cause of all his trouble I did not open the common duct, but stitched a tube into the stump of the cystic duct and drained the abscess cavity. He showed no bad effects from the operation, but his vomiting continued just the same, and no bile being discharged from the drain, eight days later through a new opening I made a gastroenterostomy by Mayo's latest method, when the patient immediately stopped vomiting and is now perfectly well, having gained forty pounds in two months.

Case VIII.—Mr. C., aged forty-five years; farmer; seen with Dr. H. Rees, of Maynard, Minn., at his own home November 20, 1904. Patient had suffered from several distinct attacks of biliary colic, usually lasting for two to three hours. The last attack commenced two weeks ago and still continues. He has been very sick ever since with a temperature ranging from 100° to 102°, with frequent chills, slight jaundice, constant pain and tenderness, with some induration in the gall-bladder region. Operation in the farm house; opened an abscess which extended from the edge of the liver to the line of the umbilicus and contained a quart of bile-stained pus. The gall-bladder filled with stones could be felt in the upper wall of the abscess cavity; no attempt was made to

demonstrate the perforation or to attempt to remove the stones at this time. The abscess was drained for four weeks, and the man slowly regained some flesh and strength, but he never felt well and suffered some pain in the region of the liver, which was supposed to be due to gallstones. On April 3d I operated upon him again at St. Luke's Hospital, St. Paul. I found a universally adherent, small, contracted gall-bladder containing thirty gallstones and no bile. In attempting to explore the ducts I found that the liver was unusually fixed. In separating adhesions between the upper surface of the liver and the diaphragm I unexpectedly put my finger into a large subdiaphragmatic abscess; without withdrawing the finger I cut down upon and resected two inches of the seventh rib in the anterior axillary line, opened the free pleural cavity and tamponed the opening all around with a thick wall of iodoform gauze until all breathing sounds were stopped, then opened the abscess through the diaphragm and let out fully eight ounces of thick, offensive pus; a counter-opening was made in the back and thorough drainage made with a rubber tube. This man made a slow recovery; seven days after the operation he discharged two gallstones from the abscess. He left the hospital six weeks after his operation with his sinuses almost closed and steadily gaining in flesh.

Case IX.—Mrs. C.; seen with Dr. Merrill, of Stillwater, Minn., aged thirty-two years; one child three weeks old; she had suffered a great deal from pain in the gall-bladder region during the last weeks of pregnancy. Jaundice and tumor appeared ten days ago. Exploration demonstrated an abscess adherent to the anterior wall containing fully six ounces of thick pus and six gallstones. She left the hospital two weeks after the operation; the discharge continued for a few days, but was entirely stopped at the end of three weeks. There never has been any discharge of bile.

Case X.—Miss C., aged thirty-two years, suffered from her first attack of colic in the fall of 1899. In December she developed typhoid; commenced having pain in the gall-bladder region during the fifth week. She steadily grew worse and was taken to Rochester, where she was operated upon by Dr. W. Mayo, January 22, 1900.

A large abscess was opened in the gall-bladder region, which in the next few days discharged five large and twenty small gallstones. She left the hospital in about one month and remained well for about four years, when she suffered from a sharp attack of biliary colic.

One year later she had a second attack, which was more intense in character and lasted three days. About a month after this attack, February 17, 1905, I operated upon her, separated extensive adhesions to the gall-bladder and liver, and removed five old black stones from the gall-bladder and drained it. Bile commenced flowing on the third day, and she soon recovered and is now apparently quite well.

I have operated upon 80 gallstone cases, 9 of which were perforative in character, and 1 postmortem, making a total of 10, which seems to be a large proportion as compared with other lists of cases already on record. There were 8 recoveries and 1 death. In this fatal case I believe that the result would have been the same even though the gall-bladder had been removed, because with gangrene of the gall-bladder and the neighboring tissues, and especially in the presence of a localized abscess, any operative work which disturbed the abscess wall would only have spread the infection and lessened the chance of recovery. I believe that in any perforative case which has gone on to the formation of a localized abscess, the wisest course is to open and drain the abscess, waiting until a later time to deal with the gallstones or the disease of the gall-bladder.

In perforative cases where the infection is not localized, then cholecystectomy with local drainage, and, if necessary, of the kidney pouch and the pelvic cavity with the Fowler position, gives the patient the best chance of escape.

If these cases prove anything, it is that gallstones should always be removed as soon as the diagnosis can be made, and in the interval, before complications have arisen to increase the danger and lessen the certainty of a perfect recovery.

## DISCUSSION.

Dr. De Forest Willard, of Philadelphia.

Inasmuch as Dr. MacLaren has referred in his paper to my case of traumatic rupture or perforation of the gall-bladder, it gives me an opportunity, after some four years, to record the final result. The child was injured by the passage of a wheel across the abdomen. I did not see him until three months later, at which time I found a large tumor occupying nearly two-thirds of the abdomen, from which I removed sixty-four ounces of nearly pure bile. This large collection had been thoroughly walled off in the peritoneal cavity. After four or five months' drainage the cavity closed entirely. I examined the boy two months since; he has no tumor in his abdomen. Whether he has a new gall-bladder or a sac which holds the bile, or whether the bile is discharged directly into the intestine from the liver, is impossible to determine. At any rate he has no discoverable tumor in the region of the gall-bladder. The stools are normal; digestion is excellent, and apparently he is a perfectly well boy.

Dr. Charles A. Powers, of Denver.

During the last six months I have operated on two cases of pathological perforation of the gall-bladder in which there were pre-existing gallstones. In each the duodenum, colon, gall-bladder, and omentum were bound together in a dense mass, and on tearing into and through this mass an abscess cavity was encountered; in one of the cases it contained two ounces of pus, in another six ounces. Through the abscess cavity the gall-bladder was found. In one of these cases through the opening in the gall-bladder a blackish, pultaceous mass presented, and on drawing on it a complete cast of the mucous membrane of the gall-bladder was removed. Both patients recovered.

Dr. W. L. Rodman, of Philadelphia.

The paper of Dr. MacLaren was of unusual interest to me, inasmuch as the last case of gall-bladder disease I operated upon was evidently one of pathological perforation of the gall-bladder. I have also seen two cases of traumatic rupture of the gall-bladder. I operated on an elderly woman, fifty-five years of age, for suspected cancer of the liver, which it proved to be at the time of operation; but whether the cancer was due to gallstones, or the gallstones due to the cancer, I am not able to say. But there was an enormous carcinomatous mass at the

site of the gall-bladder, obscuring really its location; an inch and a half or two inches from what I took to be the site of the gall-bladder was a nodule which I, at first, thought was cancerous, but a more careful examination convinced me that it was a gallstone. Cutting down into the substance of the liver, near the anterior margin, I extracted a gall-stone about the size of a hazel-nut, and around this were a few drops of grayish pus, quite sterile. It is the only case I have seen, yet I have thought that they undoubtedly occur more frequently than we think.

Dr. Robert F. Weir, of New York City.

Many years ago, before we were so far advanced in abdominal work as we are to-day, I had three cases which presented symptoms that simulated appendicitis. Great pain and tenderness existed in the right iliac region. On opening the abdomen in the first case I found a collection of matter and supposed I had to deal with an appendicular abscess. In those days we were not eager to take out the appendix, and contented ourselves with simply opening the abscess. It was, therefore, incised, drained, and packed. The second day after the operation pure bile came out. I let it alone and it took care of itself and eventually the cavity closed.

The second case was also supposed to be one of appendicitis. The usual incision through the abdominal wall was made (this was prior to McBurney's intramuscular method). I encountered considerable bilious and purulent fluid under the omentum, and found on further examination a perforated gall-bladder due to the impaction of gall-stones. The gallstones were removed, drainage established in that region, and the patient recovered.

The third patient was likewise thought to have appendicitis. In addition to finding in this case considerable bile-looking material, there was a bad general peritonitis, due evidently to a perforative infection of the gall-bladder; cleansing and drainage were employed, but the patient succumbed.

Dr. George Tully Vaughan, of Washington, D. C.

I recall a perforation of the gall-bladder in a case of typhoid fever. The patient was thought to have a perforation of the intestine. There was no question as to the patient having typhoid fever. He developed general peritonitis, which had existed for about three days before the operation. His abdomen was full of pus, and I simply opened it and removed the pus. I could not find any perforation of the intestine. I did not proceed further with my examination, but simply instituted drainage. The man died in forty-eight hours thereafter. At the

necropsy perforation of the gall-bladder was found, but no perforation of the intestine. There was no evidence whatever of gallstones in this case.

Dr. John Collins Warren, of Boston.

We all appreciate the fact that gallstones may pass into the intestine through a perforation in the intestinal wall; and that possibly some forms of obstruction of the bowel are due to a large gallstone or gallstones which have not passed through the duct, but have passed from the gall-bladder into the intestine. Dr. MacLaren recognizes that fact as well as the rest of us.

I remember one case in which there was perforation through the abdominal wall without any symptoms of an inflammatory character or changes, but in which the tumor of the skin was supposed to be malignant. On cutting down I found a number of gallstones and a small biliary fistula which healed subsequently.

Dr. Maurice H. Richardson, of Boston.

In acute infections perforation of the gall-bladder is a rare accident. When no perceptible lesion is present it must be especially infrequent. I have operated on many cases of acute cholecystitis, with more or less advanced gangrene; and even in these cases extravasation of gall-bladder contents has been unusual. In one instance I found the right upper quadrant flooded with bile which had escaped from a gall-bladder that was apparently normal. Drainage was successful.

I have been impressed by the great diversity in the pathology of gall-bladder disease. The biliary passages may be the seat of the most complicated lesions. The possible complications met with in gall-bladder surgery are infinitely greater than in that of the appendix.

Dr. Warren spoke of the escape of gallstones into the intestine. I once removed a gallstone large enough to obstruct the small intestine. The patient never had had any pain; yet, as I say, a gallstone had escaped from his gall-bladder and had obstructed completely the small intestine.

I am beginning to learn how little I know about gallstones, and frequently I find myself obliged to abandon my previous ideas in regard to this subject. I have always said, for example, that gallstones impacted in the hepatic duct must produce jaundice. Recently I removed twelve gallstones from the hepatic duct and three gallstones from the common duct in a patient who had never shown a trace of jaundice. In another case, after I had removed a large number of stones from the common and the hepatic duct, a hundred and fifty more were, in the course of

a few weeks, discharged through the tube. It is probably true that in such cases there is no real impaction; the gallstones, especially if they exist in large numbers, permit the percolation of bile between them. The biliary tract is an exceedingly interesting and prolific field, but we must remember that we do not really know much about it. Even from the experience of a large number of cases we cannot deduce any fixed rule.

I call to mind a curious case upon which I operated recently. One of my old assistants supposed that he had removed the gall-bladder. As the symptoms recurred he removed a second. I found at my operation—the third—the remains of a gall-bladder dilated sufficiently to cause renewed symptoms. The fact is that only a part of the gall-bladder was removed at the first and second operations, and the small portion still remaining became dilated to the size of a small pear. I believe that I took out the gall-bladder and the cystic duct down to the common duct; but I may be mistaken, and the old symptoms may yet reappear. Many things in gall-bladder surgery are curious and almost unbelievable.

Dr. N. B. Carson, of St. Louis.

Every time we open the abdomen we are uncertain as to what we are going to find. Such a condition occurred recently in a case I operated upon. I expected to find gallstones when I entered the gall-bladder, but found a small quantity of pus and bile mixed, and proceeded to search for the stone; this I found later in the cystic duct. It was as large as the end of my finger and had completely occluded the duct. During the progress of the operation I was very much surprised to find a mass which resembled brain-like material, and a piece about the size of my thumb was forced out and projected at least two feet from the wound. This surprised me very much. I went on with the operation, and tried to find whence this came. Later I found a large cavity the size of an egg, or may be larger, filled with this peculiar brain-like material, with a perfectly smooth cyst wall. This sac was apparently situated between the gall-bladder and the surface of the liver. I am a little uncertain as to the exact relationship of this sac and what the contents were, because the examination had not been completed when I left home.

Dr. George R. Fowler, of Brooklyn.

In regard to the matter of obstruction of the intestine due to the presence of large gallstones, I have duplicated the experience of Dr. Richardson. The patient was a man, aged fifty-four years, who de-

clared that during his entire life he never had the first suggestion of an abdominal pain. He came under my observation with a gallstone which had passed out of the gall-bladder into the intestine, and had been arrested, not by any cancerous nor other neoplasm, nor by any inflammatory swelling. By its size alone it had caused blocking of the normal and small intestine, causing absolute intestinal obstruction. This was relieved by operation; recovery of the patient followed.

Dr. Rixford, of San Francisco.

I have recently operated upon two cases of perforation of the gall-bladder, each typical of its class. The one occurred in a woman of sixty and was a septic perforation of the gall-bladder on the side toward the liver and gave rise to an abscess largely in the liver substance holding several ounces of pus. The abscess cavity contained two very large gallstones, which were faceted and in contact with the upper stone of a series of five which filled the large gall-bladder. In a preliminary operation the abscess was drained across the peritoneum and two weeks later the gallstones were removed by cholecystostomy. The sinus failed to heal and subsequently the gall-bladder was removed. The second case was one of aseptic perforation of the gall-bladder in a young man, the result of ulceration from pressure of gallstones. The patient had been a sufferer from "bilious attacks" for years, but gallstones had not been suspected as the cause. Perforation occurred while the patient was walking on the street apparently in perfect health. The symptoms of the perforation were the classical ones of sudden agonizing pain with shock and abdominal rigidity, but they lasted only eight or ten hours. At the end of twenty-four hours when I saw him there remained some slight abdominal tenderness and rigidity, but it was evident that there was very little if any peritonitis. Operation on the second day showed aseptic bile free in the peritoneal cavity, but no peritonitis beyond slight redness and congestion. The gall-bladder was full of stones and was perforated at its fundus. Cholecystectomy without drainage sufficed to cure. This case is a good example of the innocuousness of aseptic bile and of the capacity of the peritoneum to deal with a large quantity of it.

In a third case operated upon some years ago the cause of perforation was a bleeding carcinoma. The gall-bladder had become so distended with blood that on the patient's making some slight exertion it burst through a carcinomatous area. Operation a few hours later revealed the condition, but it was not possible to stop the oozing, of which the patient died some forty-eight hours later.

Dr. W. D. Haggard, of Nashville, Tenn. (by invitation).

I am very appreciative, Mr. President, of your courteous invitation to take part in this discussion, and I shall only take occasion to speak of one case of perforation of the gall-bladder which appeared to me quite unique.

This man had acute cholecystitis with gallstones, and it appeared to be the part of wisdom to refrain from an operation during the acute stage. He improved somewhat, but after two weeks of illness he was brought to the hospital with dulness from the umbilicus down; he had considerable pain, some elevation of temperature, and an accelerated pulse rate. My own idea was at the time that he had an appendiceal abscess, although primarily I made a diagnosis of acute cholecystitis with gallstones. After keeping him under observation for some days, expecting to operate for an abscess, I made a median incision above the symphysis and greatly to my surprise found a collection of dark blood, which amounted to about three or four pints. It was entirely encapsulated, and in irrigating the cavity four or five gallstones were found between the gall-bladder and rectum at the bottom of the cavity, showing there was a perforation of the gall-bladder, and still more curiously there was not a suppurative process, but perhaps an aseptic one, which was only attended with hemorrhage. I tried, at first, to make acute hemorrhagic pancreatitis out of this case, but the blood should have been subperitoneal, and the stones were unquestionably biliary calculi. The man made an uninterrupted recovery.

A curious feature was that there was no suppurative process apparently; that he had survived the perforation of the gall-bladder, and I think this case differs from any of those which I have heard spoken of this morning. The only one comparable to it is a case of Dr. Cartledge, of Louisville, in which after perforation of the gall-bladder he found a bleeding vessel in the gall-bladder at the time of operation.

Dr. MacLaren. This has been a profitable experience meeting, and I am glad that so many cases of perforation of the gall-bladder have been reported. It seems to me that a large number of the cases reported were not true perforation, but pathological perforations of the gall-bladder, followed by the formation of localized abscesses. I have not had a large experience in this particular field of work; but I assure you that we do not neglect our cases in our part of the country. Dr. Mayo gets most of them, but I get a few, and these are neglected cases, all of them, and it seems strange that we should find so many perforations of the gall-bladder.

Dr. Warren spoke of one case where a fistula had formed. We cannot be positive that a fistula has formed unless stone is passed.

I am a little surprised at the statement of Dr. Richardson, considering the large amount of material we know he has, and the beautiful work he does in this field.

Dr. Rodman believes that the only course to pursue in a case of perforation of the gall-bladder is to resort to cholecystectomy. I think that is a mistake. I believe cholecystectomy in the presence of gangrene of the gall-bladder, or in the presence of localized abscess, is bad surgery. We should treat these cases as we do appendiceal abscesses, open and drain at an early period, and wait for a secondary operation.

Recently I operated upon a case of Dr. Mayo's, of a girl who had a typhoid perforation. He operated upon her in the fifth week, and through an abscess there were discharged twenty gallstones. Four years later she came back and I removed her gall-bladder, which contained eight or ten more. She is now apparently well.

All of the cases which were reported by Drs. Willard, Powers, Rodman, Haggard, and Rixford are very interesting to me, because, I am sure, if we investigate these cases more carefully we will find there are many more of these pathological perforations of the gall-bladder than we have been led to believe.

# A SIMPLE ASEPTIC SURGICAL TECHNIQUE.

By DUDLEY P. ALLEN, M.D.,
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THE observations recorded in this paper have for their object to establish an aseptic technique, at once simple and effective. They were all conducted under the same essential conditions of sterilization of the hands. Rubber gloves, sterilized by boiling, were used in every case. The conclusions rest upon 377 bacteriological examinations of the hands of the operator and his assistants, six in number, and upon the results obtained in 3500 operated cases.

The bacteriological investigations were conducted by my present First Resident Assistant, Dr. R. W. Elliott. The clinical records were compiled by my late First Resident Assistant, Dr. A. I. Ludlow, who was assistant in the hospital throughout the whole period during which the cases were under treatment. To ensure accuracy the record of cases has been reviewed by the entire staff of assistants, resident throughout the period.

The work was suggested by the very interesting and valuable papers of Harrington, Monks, and Ochsner, published in the TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION, in 1904. A further incentive to the work came from the observations recently made in many European clinics that rubber gloves were not in common use. Strong objection was repeatedly offered to the use of gloves on the following grounds:

1. That the hand enclosed in a rubber glove for a considerable period was sure to develop abundant growths of bacteria.

2. That the puncture of the glove during operation would result in their escape into the field of operation.

3. That gloves were a serious hindrance in operating, and,
4. That they were too expensive.

The observations recorded would indicate, first, that rubber gloves are a great protection to both the surgeon and the patient, and, second, that a very simple technique may be absolutely relied upon to secure asepsis.

The following bacteriological observations, conducted in seven series, indicate sufficiently clearly the methods employed. The observations were made upon the first operations of each day, so as to represent the first sterilization of the hands.

Series A, B, and C were observations made upon the hands of the operator only, since his hands were usually encased in gloves when handling dressings and wounds and in making vaginal and rectal examinations, and thus were less liable to have on them infectious material than were the hands of the assistants, constantly working in the hospital, although the assistants, as a rule, wore rubber gloves while doing surgical dressings.

In Series D to G, cultures were made from the hands, both of the operator and his various assistants. The bacteriological observations are based upon cultures made upon numerous media—viz., plain, glycerin, glucose and hydrocele agar, bouillon, bouillon with glucose, and blood serum. Cultures taken from the hands of different assistants were usually made upon different media. The cultures were taken after removing the gloves at the close of operation, by rubbing a small swab of cotton between the fingers and about the bases and tips of the nails. In washing the hands the scrub brush was used not to exceed two minutes. It was used chiefly on the palms of the hands and about the tips of the fingers. The nail cleaner was used beneath the nails only, and never about the base of the nails. The backs of the hands and the arms were washed with soft soap, and were thoroughly rubbed with a towel or gauze. The scrub brush was never used upon the arms. A fresh, sterile operating gown was used in each operation, usually with sleeves reaching only half way from shoulder to elbow. Thus the operator's arms were bare from just above the elbow to the top of the glove, which reached about

three inches above the wrist. This method was preferred to the long sleeve, since if by chance the arm touches anything outside of the operation, it is at once perceived by the operator. This is not true when the arm is covered by a long sleeve. Further, the gloved hands and arms are repeatedly cleansed in sterile water. No germicide is used either upon the wound or hands during operation.

Rubber sleeves, covering the entire arm were used only in operations where grave sepsis or abundant pus was present. They were employed only to protect the operator's arms. The operator, assistants, and nurses always wore caps, covering the hair and ears.

In the various series of observations following, record is made, (1) of the method employed for cleansing and (2) sterilizing the hands, (3) the time occupied by the various operations, (4) the nature of the operation, whether clean or septic, (5) the number of operations made for each period of time observed—*e. g.*, four operations occupying fifteen minutes each, etc., (6) the result—viz., whether the cultures were negative or fertile, and if fertile what growth was found. The results of the observations are as follows:

Series A. Cultures were all negative. The use of Harrington's solution, though showing sterile results in each observation, was unsatisfactory, since it caused irritation of the skin of the hands and arms, and rendered the nails brittle.

To overcome this difficulty the hydrochloric acid was omitted from the solution. This solution also proved to be irritating. The results obtained by this method, Series B, were equally successful with the former method. In Series A and B, after washing the hands in Harrington's solution, sterile water only was used in the gloves.

In Series C, the hands, after washing, were thoroughly bathed in 70 per cent. alcohol. The gloves were in sterile water when put on, no alcohol being used in the gloves. As a disinfectant alcohol proved inefficient. Out of 42 observations pyogenic organisms were found twenty times, or in nearly 50 per cent. of the cases.

Puncture of the gloves in these cases might well have caused infection of the field of operation.

In Series D, E, F, and G, a solution of bichloride of mercury of varying strength was employed. The arms and hands were thoroughly washed with bichloride solution, and commonly both hands and arms were immersed in it, and the gloves were filled with the solution before being put on.

In Series D, F, and G, alcohol was used in cleansing the hands before putting on the gloves. In Series E no alcohol was used.

In the 285 observations made by the use of a solution of bichloride of mercury in the gloves, the hay bacillus was found once and the staphylococcus pyogenes albus was found twice. In each of these cases the growth did not appear until after several days, making it probable that it had slight virulence.

The object of using a solution of bichloride of mercury in the gloves is that its prolonged contact with the hands inhibits the development of bacteria. That it actually did this is evidenced by the fact that the cultures were taken from the hands after operations of all lengths, from ten minutes to one hour and forty-five minutes, and that they remained sterile.

The conclusions reached from these observations are:

1. By the use of Harrington's solution the hands may be rendered sterile, and will remain so in sterile gloves containing only sterile water. The writer found this solution irritating to hands and arms and undesirable on this account.

2. Hands thoroughly cleansed and later washed in alcohol develop the pathogenic bacteria when encased in gloves containing only sterile water. No experiments were made with gloves sterilized dry, and dusted with powder to facilitate putting them on. It seems, however, that bacteria would develop on hands encased in these gloves and moistened by perspiration, as certainly as on hands moistened by sterile water. While the dry glove dusted with powder might be used after disinfection with Harrington's solution, or one equally efficient, it would not seem safe under other conditions.

3. By washing the hands thoroughly and encasing them in

rubber gloves filled with a solution of bichloride of mercury, the hands develop pathogenic bacteria in so small a percentage of cases that the danger of sepsis is virtually destroyed.

As a result of the observations the method of sterilization determined upon is simply to wash the hands thoroughly, first with soap and water, and then with a solution of bichloride of mercury, of a strength of from 1 : 3000 up to 1 : 5000, and afterward to encase them in gloves containing the same solution. The writer uses 1 : 5000. Neither solution caused any irritation whatever to the hands of either the operator or any of his assistants. The use of alcohol in washing and disinfecting does not seem to be essential and has been discarded.

The clinical observations recorded in this paper are based upon 3500 operations. In the study of infection it has been thought wise to select only the clean cases. Cases infected before operation and cases in which prolonged drainage has been employed, as in cases of operation on the biliary tract, obviously should not be included. Also, cases which have died from shock, hemorrhage or other cause similarly unconnected with sepsis have been omitted as not bearing upon the question under discussion. All other clean cases operated upon within the period under observation are included.

The appended table of operations developing sepsis show the surgical number of the case, the diagnosis, operation, suture material, the number of days after operation when infection appeared, the degree of sepsis, and the final result. Cases of but a single stitch abscess are included in the table. In almost all cases the infection has been slight and of short duration. In one case of suture of a floating kidney the suppuration of the wound was general and prolonged.

In the series are 967 laparotomies. Of these 687 were clean and 280 were cases septic before operation. Of the total number of clean laparotomies stitch abscesses developed in 19 cases.

In the series of 2533 operations, other than laparotomies, 1452 were not septic before operation. In this series stitch abscesses developed in 39 cases and erysipelas developed in 1 case.

In the entire group of 2139 clean operations stitch abscesses developed fifty-eight times, or in about 2.25 per cent. of the cases. It is, of course, possible that some cases of infection may have escaped record, or have been overlooked in collecting the statistics, but the number of these must be very few, since the records are kept with unusual accuracy. The stitch abscesses developed in 35 cases in which chromic catgut was used. In 2 cases silk, in 1 silver wire, in 1 kangaroo tendon, in 3 silkworm gut were employed, and in the remainder the suture material used was not recorded. Since it has been the custom to use chromicized gut in uniting the fascia in all laparotomies, hernias, etc., there is little question that infection in these cases in which the suture material is not recorded was associated with the use of chromicized gut. The chromic gut used for suture was usually No. 3.

In the entire series of 2139 operations upon clean cases, sepsis was the cause of death in only 2 cases.

The results obtained in the foregoing cases were, except for the experiments detailed in Series A, B, and C, secured under essentially the same conditions, so far as sterilization of the hands and the use of gloves were concerned. In approximately the first two-thirds of the series, the hands were washed in soap and water and then washed in alcohol before putting on the gloves in bichloride solution. No difference in the results has been observed by omitting the alcohol.

In the first two-thirds of the cases the patients had a thorough antiseptic preparation in the wards, the afternoon preceding operation, a preliminary dressing being applied to the field of operation at this time. In the last third, the patients, when not too feeble, received a thorough tub bath in the ward on the morning of operation, were then clad in clean linen and placed in a clean bed. The field of operation was commonly shaved the day preceding operation. After reaching the operating room the field of operation was scrubbed with soap and water. In the later cases no scrub brush was used except in hand and foot cases. Ether and alcohol were used, and lastly a solution of 1: 3000 bichloride of mercury was poured over the operative field. No mask was

used over the face of either operator or assistant, but care was taken to talk as little as possible with the face directed toward the wound.

The dressings were sterilized once for thirty minutes under fifteen pounds of pressure, being wrapped in cotton cloth, before being placed in the sterilizer. This outer cloth cover was removed when the dressings were placed on the operating table. The efficiency of the sterilization was tested by control sterilization of septic dressings, sterilized under the same conditions as the surgical dressings.

The catgut employed was prepared by several different commercial houses, each strand being in a separate glass tube.

In a series of cultures conducted with specimens of chromicized gut secured from numerous different manufacturing houses, the cultures were negative. Control cultures were also conducted with this series of observations.

The development of pus so largely in cases in which buried chromicized gut sutures were used, its late appearance, the fact that it was almost always at the site of the knot, and the further fact that cultures from this pus on examination usually proved to be sterile, and also that suppuration ceased with the evacuation of the knot, all these facts together strongly suggest that the large knot acted as a foreign body, and being near the surface, induced secondary infection.

The conclusions reached after a bacteriological study of the hands of operator and assistants is that washing the hands in soap and water, bathing them in a solution of bichloride of mercury, 1 : 5000, and encasing them in rubber gloves boiled and filled with the same solution of bichloride of mercury is a thoroughly reliable method.

The clinical results obtained seem to show that a general bath and clean linen are as efficient as to attempt sterilization of the field of operation in the ward. The field of operation may be prepared with entire safety upon the operating table. The face mask does not appear to be an essential to aseptic operations. The rubber glove, if properly made, is no impediment to the

operator accustomed to its use. It is an almost absolute protection to the patient from the hands of the operator. Only second in importance to its value to the patient is its value to the operator in protecting his hands from infection. While the writer suffered not infrequently from slight infections from hangnails or pricks by needles made during operations, previous to the use of gloves, he has not had a single infection of the hands of any sort whatever in the long series of operations in which gloves have been used. Compared with these great advantages to both patient and operator the cost of rubber gloves is of small consideration. The form and quality of the glove is of much importance. The writer's observation of the gloves manufactured in Europe has been that they are usually of unsatisfactory form and quality.

Since No. 3 chromicized catgut was employed in so large a proportion of cases in which pus developed after operation, and since the pus did not appear, as a rule, until many days after operation, and then occurred at the site of the knot, and the further fact that the suppuration commonly ceased with the evacuation of the knot of gut, it would seem that the chromicized gut leaves something to be desired as a suture material, especially when employed near the surface of a wound. Doubtless a small-sized chromicized gut is less liable to cause difficulty than a large size.

In conclusion we would present the above methods as at once simple, economical, time-saving, of easy application under a wide range of conditions, and thoroughly reliable.

The simple conditions are to wash the hands and arms thoroughly, taking care not to injure the skin with the scrub brush or the matrices of the nails with the nail cleaner, and after washing them thoroughly in a solution of bichloride of mercury to encase the hands while operating in rubber gloves filled with the same solution.

SERIES A.—Harrington's Solution.* Gloves in sterile water.

| | Time. | Nature. | Number. | Result. |
|---|---|---|---|---|
| WASHING. | 0.15 | Clean | 4 | Negative. |
| | 0.60 | Clean | 2 | " |
| Soap, water | 0.30 | Septic | 2 | " |
| Scrub brush | 0.15 | Clean | 2 | " |
| Nail cleaner | 0.40 | Septic | 2 | " |
| | 0.30 | Clean | 2 | " |
| | 0.30 | Clean | 2 | " |
| | 0.50 | Clean | 2 | " |
| | 0.30 | Septic | 2 | " |
| | 0.50 | Septic | 2 | " |
| | 0.60 | Clean | 2 | " |
| | 0.20 | Clean | 2 | " |
| | | Total . . . | 26 | |

SERIES B.—Harrington's Solution, without HCl.* Gloves in sterile water.

| | Time. | Nature. | Number. | Result. |
|---|---|---|---|---|
| WASHING. | 0.30 | Clean | 6 | Negative. |
| | 0.35 | Clean | 4 | " |
| Soap, water | 0.60 | Septic | 4 | " |
| Scrub brush | 1.30 | Clean | 4 | " |
| Nail cleaner | 0.20 | Septic | 2 | " |
| | 0.15 | Septic | 4 | " |
| | | Total . . . | 24 | |

* Harrington's Solution:

| | |
|---|---|
| Alcohol, 95 % . . . . . | 640 c.c. |
| Hydrochloric acid . . . . . | 60 c.c. |
| Water . . . . . | 300 c.c. |
| Bichloride of mercury . . . . . | 0.8 gm. |

SERIES C.—Gloves in sterile water.

| | Time. | Nature. | Number. | Result. |
|---|---|---|---|---|
| WASHING. | 0.40 | Septic | 2 | Negative. |
| Soap, water | 0.30 | Clean | 4 | " |
| Scrub brush | 0.50 | Septic | 2 | " |
| Nail cleaner | 1.20 | Clean | 2 | " |
| Alcohol, 70 % | 0.45 | Clean | 2 | S. pyogenes albus. |
| | 0.50 | Clean | 4 | " " |
| | 0.15 | Septic | 2 | Negative. |
| | 0.60 | Septic | 5 | " |
| | 0.60 | Septic | 1 | S pyogenes albus. |
| | 1.20 | Clean | 2 | " " |
| | 0.40 | Septic | 2 | " " |
| | 0.60 | Clean | 2 | Negative. |
| | 0.35 | Septic | 2 | S. pyogenes albus. |
| | 1.30 | Clean | 3 | " " |
| | 1.30 | Clean | 1 | Negative. |
| | 0.20 | Clean | 2 | " |
| | 1.10 | Clean | 4 | S. pyogenes albus. |
| | | Total . . . | 42 | |

SERIES D.—Gloves in bichloride solution, 1 : 5000.

| | Time. | Nature. | Number. | Result. |
|---|---|---|---|---|
| | 0.60 | Clean | 6 | Negative. |
| | 1.30 | Clean | 6 | " |
| | 0.60 | Septic | 6 | " |
| WASHING. | 1.20 | Clean | 6 | " |
| Soap, water | 0.20 | Septic | 2 | " |
| Scrub brush | 0.35 | Clean | 10 | " |
| Nail cleaner | 0.30 | Clean | 15 | " |
| Alcohol, 70 % | 0.10 | Septic | 4 | " |
| | 0.15 | Septic | 2 | " |
| | 0.50 | Clean | 6 | " |
| | 0.30 | Clean | 1 | S. pyogenes albus. |
| | | Total . . . | 64 | |

SERIES E.—Gloves in bichloride solution, 1 : 5000.

| | Time. | Nature. | Number. | Result. |
|---|---|---|---|---|
| WASHING. | 1.15 | Septic | 2 | Negative. |
| Soap, water | 1.15 | Clean | 12 | " |
| Scrub brush | 1.30 | Septic | 10 | " |
| Nail cleaner | 0.45 | Clean | 13 | " |
| | 1.45 | Clean | 2 | " |
| | 0.20 | Clean | 6 | " |
| | 0.50 | Septic | 12 | " |
| | 0.60 | Clean | 8 | " |
| | 0.40 | Septic | 6 | " |
| | 0.40 | Clean | 4 | " |
| | 0.30 | Clean | 16 | " |
| | 2.00 | Clean | 6 | " |
| | 0.15 | Clean | 4 | " |
| | 0.45 | Clean | 1 | Hay bacillus. |
| | Total . . . | | 102 | |

SERIES F.—Gloves in bichloride solution, 1 : 3000.

| | Time. | Nature. | Number. | Result. |
|---|---|---|---|---|
| WASHING. | 0.60 | Septic | 6 | Negative. |
| Soap, water | 0.45 | Clean | 4 | " |
| Scrub brush | 0.50 | Clean | 8 | " |
| Nail cleaner | 0.50 | Clean | 1 | S. pyogenes albus. |
| Alcohol, 70 % | 0.15 | Septic | 4 | Negative. |
| | 0.30 | Clean | 8 | " |
| | 0.40 | Septic | 8 | " |
| | 1.20 | Clean | 4 | " |
| | 0.60 | Clean | 10 | " |
| | 1.45 | Clean | 6 | " |
| | 0.15 | Clean | 4 | " |
| | 0.30 | Septic | 12 | " |
| | Total . . . | | 75 | |

SERIES G.—Gloves in bichloride solution, 1 : 4000.

| | Time. | Nature. | Number. | Result. |
|---|---|---|---|---|
| WASHING. | 0.40 | Septic | 6 | Negative. |
| Soap, water | 0.30 | Clean | 10 | " |
| Scrub brush | 0.50 | Septic | 10 | " |
| Nail cleaner | 1.40 | Clean | 2 | " |
| Alcohol. 70 % | 0.15 | Septic | 6 | " |
| | 0.60 | Clean | 2 | " |
| | 1.20 | Clean | 8 | " |
| | Total . . . | | 44 | |

## Herniæ.

| No. | Diagnosis. | Operation. | Suture material. | No. of days after operation. | Cultures when taken. | Nature of infection. | Result. |
|---|---|---|---|---|---|---|---|
| 1962 | Hernia, inguinal | Herniotomy | Chromic gut | 7 | ..... | Stitch abscess | Recovery. |
| 3054 | " | " | " | 10 | ..... | " | " |
| 3105 | " | " | " | 11 | ..... | " | " |
| 3225 | " | " | " | 5 | ..... | " | " |
| 3836 | " | " | " | 12 | ..... | " | " |
| 4646 | Hernia, femoral | " | " | 13 | ..... | " | " |
| 4657 | Hernia, inguinal | " | " | 6 | ..... | " | " |
| 5013 | " | " | " | 13 | ..... | " | " |
| 5214 | " | " | " | 12 | ..... | " | " |
| 5742 | " | " | " | 7 | ..... | " | " |
| 5749 | Hernia, double | " | " | 10 | ..... | " (one side) | " |
| 1206 | Hernia, inguinal | " | Silk | 10 | Staph. pyog. aureus | " | " |
| 1257 | " | " | Silver wire | 21 | " | " | |
| 1313 | " | " | Kangaroo tendon | 7 | " | " | " |
| 3054 | " | " | Chromic gut | 10 | ..... | " | " |
| 3105 | Hernia, strangulated | (cocaine anæsthesia) | " | 11 | ..... | " | " |
| 3225 | Hernia, inguinal | Herniotomy | " | 4 | ..... | " | " |
| 3445 | " | " | " | 11 | ..... | " | " |
| 3836 | " | " | " | 12 | ..... | " | " |

## Appendicitis.

| No. | Diagnosis. | Operation. | Suture material. | No. of days after operation. | Cultures when taken. | Nature of infection. | Result. |
|---|---|---|---|---|---|---|---|
| 1472 | Appendicitis, chronic | Appendectomy | Not stated | 10 | ..... | Stitch abscess | Recovery. |
| 1475 | " | " | " | 8 | ..... | " | " |
| 3043 | " | " | Chromic gut | 10 | ..... | " | " |
| 3602 | " | " | " | 12 | ..... | " | " |
| 1352 | Appendicitis, acute | " | Not stated | 10 | Staph. pyog. aureus. | " | " |
| 1668 | Appendicitis, chronic | " | Chromic gut | 4 | ..... | " | " |
| 1883 | " | " | Not stated | 2 | ..... | Pus in wound | Died 6th d. pneumonia |
| 3043 | " | " | Chromic gut | 9 | ..... | Stitch abscess | Recovery. |
| 3319 | " | " | " | 2 | ..... | " | " |

## Miscellaneous Laparotomies.

| No. | Diagnosis. | Operation. | Suture material. | No. of days after operation. | Cultures when taken. | Nature of infection. | Result. |
|---|---|---|---|---|---|---|---|
| 1435 | Hernia, ventral | Laparotomy | Chromic gut | 10 | ..... | Stitch abscess | Recovery. |
| 2069 | Salpingitis | Salpingo-oöphorec'my | " | 9 | ..... | " | " |
| 2458 | Hernia, ventral | Laparotomy | " | 5 | ..... | " | " |
| 4464 | " | " | " | 12 | ..... | " | " |
| 1242 | Salpingitis | Salpingo-oöphorec'my | Silkworm gut | 7 | Staph. pyog. aureus. | " | " |
| 1255 | Dilated stomach | Gastroenterostomy | " | ... | ..... | Peritonitis. | Died 5th day |
| 1380 | Carcinoma stomach | " | " | 10 | ..... | Stitch abscess | Recovery. |
| 2019 | Tubercular salpingitis | Salpingo-oöphorec'my | Chromic gut | 27 | ..... | " | " |
| 2177 | Cystic ovaries | Oöphorec'my | Not stated | 7 | ..... | " | " |
| 4984 | Uterine fibroid | Hysterect'my abd. | Chromic gut | 4 | ..... | " | " |

### Varicocele.

| No. | Diagnosis. | Operation. | Suture material. | No. of days after operation. | Cultures when taken. | Nature of infection. | Result. |
|---|---|---|---|---|---|---|---|
| 2481 | Varicocele | Excision | 1 silkworm gut stitch | 6 | ..... | Stitch abscess | Recovery. |
| 3947 | " | " | Chromic gut | 8 | ..... | " | " |
| 2953 | " | " | " | 7 | ..... | " | " |
| 3022 | " | " | " | 21 | ..... | " | " |
| 3227 | " | " | " | 5 | ..... | " | " |
| 3729 | " | " | " | 11 | ..... | " | " |
| 3947 | " | " | " | 8 | ..... | " | " |
| 4006 | " | " | " | 7 | ..... | " | " |

### Varicose Veins.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1930 | Varix leg | Circular division | Not stated | 10 | ..... | Stitch abscess | Recovery. |
| 4555 | " | Phlebectomy | " | 6 | ..... | " | " |
| 1299 | " | " | Plain catgut | 4 | Staph. pyog. albus | " | " |
| 1390 | " | Circular division | Not stated | 4 | ..... | " | " |
| 1498 | " | Phlebectomy | Silkworm gut | 9 | ..... | " | " |
| 2753 | " | " | Not stated | 4 | B. mucosus capsulatus | " | " |
| 3302 | " | " | Celluloid thread | 10 | ..... | " | " |

### Miscellaneous.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1732 | Hydrocele | Excision | Not stated | 4 | ..... | Stitch abscess | Recovery. |
| 4069 | Bursa olecranon | " | " | 6 | ..... | Erysipelas | " |
| 4527 | Movable kidney | Fixation | Chromic gut | 12 | ..... | Perinephritic ab | " |
| 1485 | Carcinoma mammæ | Excision | Silk suture | 11 | ..... | Stitch abscess | " |
| 1906 | Deformed toe | Amputation | Silkworm gut | 5 | ..... | " | " |

## DISCUSSION.

Dr. A. J. Ochsner, of Chicago.

If chromicized catgut is preserved in a solution consisting of one part of iodoform, five of ether, and fourteen of commercial alcohol, this trouble described by Dr. Allen will stop. Many surgeons who have had the same experience before using this have no trouble now, because iodoform will permeate the entire suture and remain until every particle of it is absorbed, supplying a mild antiseptic.

Dr. Robert F. Weir, of New York.

I do not think that we are all in accord with the views of Dr. Allen. Before proceeding further I would like to ask him what strength of solution of bichloride of mercury he puts in his gloves?

Dr. Allen. One to three thousand, or one to five thousand.

Dr. Weir. Most of us have passed through a series of experimentations, either by personal work or by close observation of others, as to this glove or no glove business. I should say the majority of surgeons in large cities are using gloves; yet, notwithstanding all that, the facts remain that if gloves are worn, no matter what method of cleansing the hands is resorted to, there will be found afterward from the maceration of the gloves evidences of germ life in the layers of the skin, many times of pyogenic germs. We have gone through this so frequently at the Roosevelt Hospital, where our method of disinfection of the hands is, I think, better than those enumerated by Dr. Allen. Bichloride of mercury solution is not always effective, for it does not penetrate partially or deeply the tissues of the skin. It has been demonstrated by experiments at the Johns Hopkins Hospital that by a process of neutralization you can get germs in the deeper layers of the skin after any disinfection of the hands. In the Roosevelt Hospital nascent chlorine is used, evolved by washing the hands with common chloride of lime, to which is added common washing soda, which sets free the chlorine which penetrates deeper than anything I know of. It leaves the skin free from germs. Even with this method, when we put on gloves and have maceration, we do get evidences of germ life, but to a less degree than by any other disinfection. There are surgeons of great ability in New York City who do not use gloves, and they do have good results. One surgeon in that city, who has the largest experience and the best reputation, does use gloves, but washes his hands with dilute aqua ammonia. Those of us who have tried to use gloves in abdominal work particularly, and

sometimes avoid them in external limb operations, find that the essential thing is to acquire manual dexterity. This distinguished surgeon, to whom I have referred, seldom breaks or pricks his gloves. If we can do that, if we know how to handle instruments properly and skilfully, and know how to insert a needle, without penetrating the glove protector, we will then have admirable results. But as this dexterity is not given to all of us the others, with myself included, must, in order to protect the patient when the glove is torn, previously disinfect his hands in the best possible manner.

I only venture to assert that for this purpose the general use of a bichloride solution is not to be commended. In addition to its unreliability the bichloride of mercury solution, whether used in the strengths enunciated by Dr. Allen, or as weak as 1:10,000, does beget, after a while, a good deal of irritation of the skin, which furnishes a better lodgement for bacteria, as this prevents the requisite cleansing outside of the question of disinfection.

Dr. W. L. Rodman, of Philadelphia.

The Association is indebted to Dr. Allen for his carefully conducted experiments extending over so long a time and being so comprehensive as they were. I feel, however, as Dr. Weir does, that it is only the lateness of the hour that prevents a protracted discussion of this subject. Certainly it is both an interesting and important one, second to none that have engaged our attention at this meeting.

I was particularly interested in Dr. Allen's report, inasmuch as it is directly in conflict with the experiments which were narrated by a number of speakers at the last meeting of the British Medical Association, held at Oxford, when the subject of asepsis versus antisepsis was up for discussion on the first day. There everyone, particularly the chemists, placed the greatest valuation on alcohol (95 per cent.). While we know that alcohol is not a germicide in the ordinary sense of the word, but is a cleanser or scavenger which gets rid of debris and epithelial tissue about the hands, it has been considered hitherto as one of the best agents that we have. Personally, I have great faith in it. I depend upon it more than anything else, and if it does nothing more to my hands, it at least hardens the skin and enables me to use chemicals, which I could not do without the preliminary use of the alcohol. I think, possibly, that Dr. Allen, while he has given us a great deal to think about, underrates the value of alcohol in operations.

Another question upon which I must take issue with him is that he seems to undervalue mechanical purification. I believe most thoroughly in that; in truth, I believe in mechanical purification more than anything

else, for I am absolutely convinced that the use of chemicals and even the use of gloves are unnecessary if one has resorted to a thorough mechanical purification with soap and water, then supplementing it with alcohol. I feel that the use of either chemicals or gloves is a work of supererogation with the careful surgeon who places the proper valuation upon mechanical purification. Moreover I think a disadvantage of the Harrington solution, to many of us, is that we cannot use it. I admit it is a good thing for those who can use it. There are many surgeons and nurses who cannot put their hands in so strong a solution of bichloride of mercury and hydrochloric acid as the Harrington solution. It might be well for the first operation; but it would leave the hands so cracked and in such a condition that they could not be made approximately aseptic for the next operation. It is a method which many cannot employ. My own belief is that rubber gloves, while valuable in many aseptic operations, find their greatest usefulness in septic cases.

Dr. Weir. I judge from the remarks made by Dr. Rodman that I did not make myself clearly understood in what I had to say. I am strongly in favor of using gloves. I use them in operating upon joints, in the abdominal cavity, but I make omissions occasionally, especially where haste or precision is required, and frequently in operations upon the extremities I do not use them. I wish to say, again, that the point I tried to make was this, that if one could thoroughly disinfect his hands and feel sure of it in every instance, I would rather do without gloves, but I do not feel that way.

Dr. Rodman. I use rubber gloves frequently, but it is not absolutely necessary.

Dr. Lewis S. McMurtry, of Louisville.

I desire to contribute a word or two to the discussion on this subject, which has brought out, as is evidenced, great diversity of opinion in the practice of aseptic methods. I take it, the value of such an able, painstaking paper, as has been read by Dr. Allen, and also the symposium presented to this Association one year ago in St. Louis, is in perfecting our knowledge of fundamental principles which underlie the aseptic surgical technique. The reason that there is so much discussion is that different surgeons have different methods, with equal success, of applying the same principles. So when we come to discuss a subject of this kind we will find that some surgeons do not use gloves in all cases, others do, and some do not at all. Some surgeons do not attach as

much value to mechanical cleansing of the hands as they do to the use of germicidal chemicals. Others value the use of alcohol; other surgeons value other agents; in the application of these principles there may be great diversity of practice, and with equal success. There is one thing that underlies success always, and that is the skill of the surgeon, and this is nowhere so manifest as in the art of maintaining cleanliness of the hands.

Dr. George R. Fowler, of Brooklyn.

I want to state in the direction of what the last speaker has said in part, but which has been well said by others long before us and after the innovation of asepsis, that success depends not so much upon the special method employed, as it does upon carrying out conscientiously and carefully a given method, based upon proper principles. The surgeon who is accustomed to one method may get just as good results, provided the method is based on proper principles and is conscientiously carried out. I was struck with one inconsistency in the paper: while the author carefully covers the hands with gloves (to which there are some valid objections), although the hands can be properly cleansed, he attaches no importance to the protection which may be afforded to the wound from micro-organisms from the mouth, and declines to cover the mouth with a mask. This is certainly important, particularly where it is necessary to talk over an open laparotomy wound, as in public clinics. It has been my practice for years to carry out this precaution, and I am quite sure it is not an unimportant part of the aseptic technique.

Dr. George Tully Vaughan, of Washington, D. C.

I understood Dr. Allen to say in his paper that there were two deaths from sepsis. I would like to ask whether these cases were clean before operation.

Dr. Allen. One was a case of chronic appendicitis, operated upon by an assistant; and the other was a case of gastroenterostomy, both of which were presumably clean before operation.

Dr. Emmet Rixford, of San Francisco.

It may not be out of place to refer briefly to a matter which is of considerable historical interest in San Francisco. Dr. Samuel Cooper, for whom Cooper Medical College is named, and who died in 1862, developed an aseptic technique which gave him results which were

extraordinary for his time. He used alcohol in 50 and 75 per cent. strengths for cleansing his hands, his wounds, the field of operation, instruments, dressings, etc. Under this technique he successfully sutured the fractured patella and olecranon, did Cæsarean section and ovariotomy. His theory was that alcohol in connection with the glorious climate of California had some peculiar effect on surgical wounds by which they would heal without suppuration.

Dr. Allen. In my paper I was careful to state that the method suggested was not the only way of operating. I presume I have seen as many operations performed by eminent men in this country and abroad as any member of this Association. I have travelled extensively and have seen the different methods in vogue, and have observed that every surgeon has a different method. Some are consistent, others are inconsistent. Last summer I saw Mikulicz operating, using a dozen or more pairs of cotton gloves in a single operation. I rarely saw rubber gloves used in any of the European clinics. In this country rubber gloves are largely used by surgeons in their operative work. In this connection I am reminded of a story. A surgeon said to Dr. Mayo that he had a certain number of successful laparotomies in unselected cases without a death, and that after considering the matter he concluded that his great success was due to the fact that he wore rubber gauntlets reaching to his shoulders. Dr. Mayo said that he also had had considerable experience in doing laparotomies and had met with ordinary success, and the reason for that success he attributed largely to his wearing rubber boots. (Laughter.)

There are many ways of accomplishing the same results. I find a great many surgeons use methods that are not only complicated, but difficult and unnecessary. Now, gentlemen, the proof of the method is the results which are obtained by it. I submit to you that the clinical results reported in this paper establish the fact that the method described is a safe one. Few clinical histories have been recorded and tabulated with greater care than these in the preparation of statistics.

Dr. Weir spoke of finding infection or germ life deep in the skin after hand disinfection. The question is not what one can find by bacterial examination of the deep layers of the skin, but what may be found upon its surface, since this is the part which breeds bacteria inside the glove. I think this is where the mistake is made in some bacteriological examinations.

As to irritation of the skin, I will say that during the time we have used rubber gloves none of us, whether in winter or summer, have suffered from irritation of the hands, and if you will pardon me I will

say here that if Dr. Rodman gets so much irritation of his hands, it is probably because his method of disinfecting the hands is bad.

One may take an hour-glass and scrub the hands and arms with a brush during the period marked by its flowing sands, as I have seen done in various clinics, and get the hands and arms so irritated that they are bound to become further irritated by the use of bichloride of mercury. Repeated disinfections only increase the difficulty. I simply use a brush to scrub the palms of the hands and around the tips of the nails, and later wash the backs of the hands and arms, using a towel or sterile gauze, and I never have an irritated hand or an irritated arm.

So far as the use of a mask is concerned, I believe one should use care in talking toward the operative field.

The absence of peritonitis, as shown in the table of laparotomies, establishes the fact that little danger results when the face mask is not used.

# THE STATUS LYMPHATICUS.

By ROSWELL PARK, M.D.,
BUFFALO, N. Y.

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The term status lymphaticus comprises a somewhat complicated pathological condition, having very much to do with perverted function of the ductless glands and disturbances in normal proportion of the so-called internal secretions, which have much more than a remote interest for the surgeon, because they are so closely allied to disturbances of nutrition and innervation, and to overgrowth of certain parts of the body. Normal relations being so far out of adjustment, the resulting condition is one which often makes the administration of an anæsthetic dangerous and the performance of otherwise clearly indicated operations even inadvisable. It has much to do also with the matter of sudden death during and after operation. Turning attention for a moment to the matter of sudden deaths, which is of such overwhelming interest for the surgeon, one may say that they have, in times past, been usually attributed to the anæsthetic or the anæsthetist, while not enough attention has been given to lesions of the lymphatic and vascular systems. While at times disturbance of the circulatory and respiratory centres may be closely associated, there are other times when there seems to be but little relation between them; as is shown by the fact that, at least in experimental animals, circulation may proceed regularly for a long time after respiration has ceased. A large proportion of cases of sudden death may be accounted for by such vascular disturbances as acute anæmia, fatty heart, rupture of vessels, syncope due to cardiac anæmia, disease of the coronary arteries, defective valves, endocarditis, etc. In the respiratory tract we may meet with pulmonary embo-

lism, œdema, asphyxia from overloading of the left side of the heart, and emphysema. Even the lesions attributed to the kidneys concern rather their vessels, and this may be true also of the nervous system. While all of these disturbances have more or less to do with the status lymphaticus, the latter is nevertheless a condition not yet widely appreciated, too often recognized only after the sudden death of its victim, and yet not so easily described or defined that it can, with certainty, be always diagnosed during life. It therefore demands careful study.

The fact that it has so much to do with the lymphatic system and the thymus necessarily calls attention to the functions of all of the temporary glands. Lymphoid tissue throughout the body seems to increase as the thymus diminishes, and it is quite likely that the former tissue assumes the work of the latter in the matter of regeneration and leukocytosis and the general growth of the body. Thus we find that in marasmus of the infant type the thymus has disappeared, and its condition is always a fair index as to the general nutrition of the infant. But it is not atrophy of the thymus that causes disturbance so much as it is hypertrophy; and the fact which is to us of the greatest interest in this connection is the liability to sudden death, during or after an anæsthetic, in cases where the thymus is enlarged. Between the pituitary body, the thymus, the thyroid, the coccygeal body (Luschka's gland), the testes, the ovaries, and perhaps the bone-marrow, there exist strange relationships which have not yet been sufficiently studied. Probably in this list, along with the thyroid, should be inserted the parathyroids—*i. e.*, those small bodies so often associated with the thyroid, sometimes embedded in it, much as are the islands of Langerhans in the pancreas, so that when the thyroid is removed they go with it. In many animals, and usually in man, these little bodies are separate, and in the latter overlooked. Experimentation has shown that after removal of these, rather than of the thyroid, there appears the full train of symptoms, such as tetany etc., which are included in the phenomena of experimental myxœdema. There can be no doubt that these small bodies are of different nature and function from those of the thyroid itself.

This has led to the inference that some of them at least have really an antitoxic function. Should this be demonstrated, the whole aspect in which we regard Graves' disease will be changed. Exophthalmic goitre used to be regarded as due to the overloading of the blood by degenerate products of a hypertrophied thyroid. These experiments raise the question of how many of these symptoms are due to excess of thyroid secretion, and how many are due rather to atrophy of the parathyroids, since nearly all of the symptoms of Graves' disease follow extirpation of the latter. This theory is strengthened by the fact that in the ordinary forms of cystic goitre, where apparently thyroid secretion must be produced in excess, the symptoms of Graves' disease are lacking. Exophthalmic goitre is seen ten times as often in women as in men, while ordinary goitre affects both sexes alike. Moreover, we may get all the signs of Graves' disease without enlargement of the thyroid, which, in these cases, seems to play little, if any, part. There is, therefore, much reason to argue that the thyroid is not the primary seat of the lesion of exophthalmic goitre, but is only secondarily involved, as, for instance, is the spleen in malaria.

It appears that when the thyroid is removed and the parathyroids remain there follow myxœdema and cachexia, the very counterpart of Graves' disease, but that when the parathyroids are removed and the thyroid left there follow severe nervous symptoms quite like those of Graves' disease. There is, therefore, strong reason for believing the internal secretion of the thyroid proper to be intimately related to the nutrition of connective tissue, and that the mucoid infiltration of myxœdema is due to degeneration in the fibrous and connective textures.

With regard, next, to the internal secretions of the testis, we are again reminded that in some respects its structure and arrangement are quite similar to those of the pancreas, since between its tubules are met small collections of cells not so definitely grouped as in the pancreas, to which hitherto little attention has been paid. These are, in all probability, the agents which secrete some other material which has largely to do with the growth and development of the body. These are quite apart from the peculiar tubular

structures concerned in the manufacture and collection of semen. Moreover, the life history of the thymus is closely related to that of the testis; atrophy of the former depends on the complete maturation of the sexual organs. In the male guinea-pig removal of the thymus is followed by more rapid growth of testes, hence there appears reciprocal relationship between thymus and testis, each influencing the growth of the other. In females this does not seem to exist; removal of the thymus does not hasten the onset of maturity.

The testicles, then, have a well-marked triple function. (*a*) They produce a substance or stimulus that certainly influences development, especially in sexual characteristics. (*b*) They produce a substance apparently essential to the psychical manifestations of sexual activity. Although these functions are related, one is essentially developmental, while the other proceeds through many years. (*c*) They manufacture spermatozoa.

Corroboration of these statements is furnished by the study of cryptorchids and castrated animals. In undescended testicles the seminal cells are usually absent, whereas the interstitial gland cells remain. Such individuals develop normally, except that they are sterile, and when such testicles are removed sexual capacity and inclination disappear. The same condition results from occlusion of the vas in man—*i. e.*, there is a disappearance of seminal cells, which is quite analogous to the atrophy of the tubular structures after occlusion of the pancreatic duct.

So far as conditions permit, similar statements can be made regarding the ovary and its internal secretions.

While the thyroid, the testes, and the ovaries, which have so much to do with nutrition, are then to some extent concerned in the production of the status lymphaticus, its more important expressions are, however, seen in involvement of the thymus and of the lymphatic tissue and apparatus throughout the body, but more particularly in its interior. The condition is met with most often in children, less often in young adults. Along with it goes such reduced power of resistance against all deleterious influences as to permit of sudden death from cardiac failure and from causes

which seem disproportionally trivial. Such deaths have occurred, for instance, not merely during anæsthesia, but from convulsions during the exanthemata and diphtheria, and even during bathing.

The status lymphaticus is also spoken of under other names, as *lymphatism*, *lymphatic constitution*, and *status thymicus*, the latter because of the apparently active participation of the thymus in some of these cases. Thymic enlargement has been often noted in times past at autopsies, but its relation to the other features which make up the general picture of status lymphaticus were unknown until Rokitansky, in 1842, first recognized the condition, but confused it with tuberculosis of the lymphatics. The death, a few years ago, of a son of Professor Langerhans, of Berlin, shortly after the injection of antitoxin intended to protect him from diphtheria, and the subsequent discovery that the boy was the victim of this condition caused a widespread interest in and study of the problems involved. These have apparently to do with the *thymus* more conspicuously than with any other isolated organ of the body. The thymus normally begins its involution within a few months after birth, and it should have disappeared at puberty. In the status lymphaticus this involution does not occur, but the enlargement persists, or even increases, up to adult life, varying greatly in different cases, its weight ranging from 20 to 135 grams.

We are as yet far from conversant with the function and purposes of the thymus, although, for convenience, it may perhaps still be grouped among the lymphatic tissues. Its juice contains numerous leukocytes which find their way into the general circulation, and it is credited with producing a secretion analogous to that of the other ductless glands. Its extract injected into dogs produces great fall of blood pressure, with acceleration of the heart, and, in fatal doses, dyspnœa and collapse. Enlargement of the thymus may cause death by pressure on important structures, even other than the trachea. Aside from dyspnœa, mechanical in character, it produces a peculiar type of asthma, which has been for some time known as *thymic asthma*, in which death sometimes occurs most unexpectedly and rapidly. In these cases autopsy rarely

reveals anything abnormal other than its enlargement, although at times the cut surfaces exude a milky fluid; but in all of these cases there will be found, in addition to changes in the thymus, a *general hyperplasia of the lymphatic system*, with enlargement of the superficial and deep nodes, especially in the neck, the axilla, the groin, and the abdomen. Furthermore, the spleen enlarges and the Malpighian bodies seem to be packed with lymphoid cells. At the same time, there often occurs enlargement of the heart and increase in the thickness of the arterial walls. All this is sometimes so marked that Virchow suggested for it the name lymphatic-chlorotic constitution. Narrowing of the aorta, which is usually noted in these cases, is really due to the same lymphoid infiltration.

Of very great import to the surgeon are the *relations between rickets and the status lymphaticus*, which are so frequent and conspicuous as to indicate more than a casual connection. Nearly all cases of lymphatism display the ordinary clinical evidences of rickets. By some such relation may be best explained the benefit which accrues in many cases of rickets from the administration of thymic or pituitary extracts.

Enlargement of lymphoid tissue occurs also in the walls of the alimentary canal and in those rings of adenoid tissue which mark the site of embryonic canals. This tissue may be seen in miniature around the base of the appendix, while its most conspicuous illustrations are seen about the pharynx, where not only the pharyngeal but the faucial and lingual tonsils are enlarged. It is in these cases that we get the so-called *adenoids* of the throat specialists, in their most conspicuous expressions, while it is of the greatest interest to the surgeon to appreciate that the deaths that have occurred in connection with the status lymphaticus have happened perhaps more often in operations upon the nasopharynx than under any other circumstances. It may be significant also that after death the normal yellow marrow of the bones seems to be replaced by red marrow.

Another expression of lymphatism may perhaps be found in what Kaposi some years ago described under the name *lymphodermia perniciosa*, a rare condition characterized by a scaly,

itching skin, exuding fluid, with later a diffuse and doughy condition of the affected parts, and then by nodules which sometimes ulcerate, the lymph nodes and spleen being also enlarged and the general health being greatly impaired.

Thymic asthma has been in times past often called *laryngismus stridulus*. Whether or not the latter often occurs without the former is not the primary question here, but their very frequent association is of great importance to the surgeon.

Medicolegal questions of no small interest also rise in this connection. In the status lymphaticus death usually occurs after a series of convulsions, and yet it may happen without a warning, just as it does during or after anæsthesia. Convulsions of any character in adolescent individuals and young children should raise a suspicion of this condition. Of still greater surgical importance is it that all possibility of the existence of the condition, when suspected, should be eliminated before operation is undertaken. It is perhaps to be feared that deaths occurring during anæsthesia are more often directly attributable to the anæsthetist than it is pleasant to acknowledge. Nevertheless, there are certainly instances of this kind where he should be held absolutely blameless so far as administration of the anæsthetic is concerned, and where death may occur as by a lightning flash.

It does not, in effect, follow that chloroform is to be blamed in these cases; rather is the blame to be ascribed to the status itself. Under these circumstances death may occur at any stage of the anæsthesia, or a little time after it has been discontinued. It is most significant that the conspicuous illustrations of the relation between the condition and sudden death have occurred during operations upon the throat and nose. This seems to show the role played by the very adenoid tissue against which the operation is directed.

It is indeed an interesting and, at the same time, an unanswerable question why individuals with well-marked status lymphaticus should live apparently comfortably for years and then suddenly succumb from some seemingly trifling cause.

The relations between the thymus and the thyroid are apparently

unmistakable, though obscure. In perhaps one-half of the cases where the thymus is enlarged the thyroid is also increased in size. Experimentally, when one is removed the other seems to undergo compensatory enlargement, as though their functions were to some degree interchangeable. Much less is known as to the relations of either of these bodies to the pituitary, and as yet nothing has appeared concerning their relations with Luschka's gland.

Diagnosis. A recognition of the status lymphaticus is not always easy. Nevertheless, there are certain features which are always suggestive and should arouse suspicion; among these the close relation between it and rickets, already alluded to, may furnish a hint, and, when recognized, a positive warning. Widespread enlargement of the lymph nodes supplies another. The presence in the nasopharynx of adenoid growths, especially when accompanied by enlargement of the spleen, should be regarded as furnishing a very suspicious connection; while if, in addition to this, the thymus be found enlarged, either by palpation or percussion, the diagnosis may be regarded as established. Moreover, these children, for such they usually are, have a pasty complexion and anxious facies, and usually a sluggish disposition. Aside from evidences of rickets, they are usually anæmic, often marasmic, with a special liability to spasm of the glottis; the thyroid is often enlarged, as well as the thymus. In young adults these conditions often simulate cretinism, in that they are retarded in growth and infantile in appearance, while sexual development is impaired.

Treatment. Naturally, in every well-marked case of status lymphaticus, one should abstain from all operative intervention, if it be possible; yet when the nose and pharynx are obstructed and oxygenation is thus interfered with, it may seem necessary to the welfare of the child to free the nasal channels for breathing purposes.

Under these circumstances it would doubtless be well to prepare the patient for the anæsthetic by spraying the nose and throat with a 1 to 2 per cent. solution of cocaine, to which a little adrenalin may be added. Inasmuch as these operations are usually quickly

performed, the best anæsthetic would probably be ethyl chloride. This, at least, may be used at first. As against the dangers of operative procedures, we may feel that we have a powerful protection in the possession of adrenalin. Assuming that the result of the experimental injection of thymic juice proves it to have a depressing and pressure-lowering effect, it will be instantly seen how much can be done to counteract or ward off danger by the use of adrenalin, both previous to the commencement of anæsthesia, and, if necessary, during it. By all means, then, the affected surfaces should be treated with the cocaine spray, in order to deaden acute liability to those impressions which, conveyed to the brain, may produce prompt vascular and cardiac disturbance. When operations must be performed on those known to be subjects of glottic spasm or laryngismus stridulus, one should be prepared to do a tracheotomy on exceedingly short notice, and if the thymus be enlarged it might be well even to make this the first operative procedure, using if necessary a long trachea tube. Should thymic enlargement itself call for operation, preliminary tracheotomy should not be omitted.

It must be said of these cases that, provided they can be successfully conducted through the particularly dangerous period, the improvement which results after completion of the surgical treatment is most gratifying; thus, for example, after clearing out a mass of adenoids from the nasopharynx the welfare of the patient is quickly enhanced.

The best measures then in case of impending or actual danger will prove to be adrenalin, artificial respiration, and tracheotomy, as emergency measures when called for.

It will frequently happen that a patient is brought for surgical attention in whom this condition may be recognized, and it should be looked for in every anæmic, ill-nourished child. Save in cases of extreme emergency, operation should then be delayed until sufficient fortification can be afforded. In some cases it may be profitably postponed for weeks or months. During this time these children should be given the benefit of most carefully selected nutrition, out-door air, sunlight, and of the especial benefits con-

ferred not alone by such preparations as the phosphates or glycerophosphates, but *by thymic or pituitary extract, in suitable doses*, administered three or four times a day. The improvement that may be seen after this method of preparation will be equally astonishing and gratifying.

Fig 1.

Fig. 2.

Congenital subacromial dislocation of left humerus. Boy, aged three years. Observe abduction and inward rotation of humerus. Before operation.

*a*. Olecranon points directly outward and external condyle forward. *b*. Head of humerus.

# A CASE OF EXCISION OF HEAD OF HUMERUS FOR CONGENITAL SUBACROMIAL DISLOCATION OF THE HUMERUS.

By JOHN B. ROBERTS, M.D.,
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The boy, aged three years, was operated upon on December 5, 1903. The head of the bone could be seen and felt under the acromial process, and the humerus was firmly abducted from the chest, with the external condyle pointing almost directly forward, instead of outward. The position of the arm and attached forearm was due to the rotation of the humerus, caused by the displacement of the head of the bone. (Figs. 1 and 2.) Voluntary elevation of the arm was impossible and other movements were restricted. It was, therefore, deemed advisable to attempt replacement of the head of the bone by operation and, in case of failure, to excise the humeral head. A vertical incision, three inches long, was made over the prominence below the acromion, through the fibres of the deltoid. The round head of the bone was covered by a deeper muscle, which was probably the infraspinate. After opening the capsule and exposing the head, attempts were made to reduce the dislocation. As reduction was impossible, an incision, about three inches long, was made in a vertical direction through the deltoid on the front of the shoulder, and carried down to the deep layers of muscle. (Fig. 3.) Counter-pressure upon the bone was made here in the endeavor to aid in the reduction of the luxation. All these efforts were unavailing. The glenoid cavity itself was not exposed, because of the depth of the wound and the youth of the child. The condition seemed to make it evident that only a prolonged and

bloody dissection would thoroughly expose the glenoid cavity. I, therefore, came to the conclusion that excision of the head of the bone would give probably as good, if not a better, joint with less risk. Reduction, with stiffness of the joint, seemed to me to be but little better than the present condition. The head of the bone was thoroughly exposed and excised through the posterior wound. The section was made with a small saw close to the head, so as to remove as little as possible of the shaft. In removing the excised fragment the long head of the biceps was divided in the depth of the wound close to the axilla. The rotation of the bone caused the bicipital groove and its enclosed tendon to be almost directly opposite the incision made on the back of the joint. The division of this muscle was not recognized at the time. Both cuts were closed without drainage, and the forearm supported by a sling. Union occurred by first intention.

When seen on March 2, 1904, the motion of the arm was good, though the limb was weak. The child had a tendency to aid it by lifting it with the right hand, when told to raise it. He could touch the ear on both sides, and the back of the head with the left hand, if the arm is aided a little with his own right hand, or an attendant's hand. This aid is needed, especially when he touches the right ear. His mother said that he always helped the dislocated arm with the other hand, and that this habit was still kept up, though there was much less need of such assistance. Frictions and calisthenic exercises were recommended.

When examined June 1, 1905, the notes made were as follows: The left humerus is considerably shorter than the right. Passive motion elicits grating at the shoulder joint. (Fig. 4.) There is possible moderate rotation, though it is not as complete as on the right side. Elevation of the humerus is restricted, and the scapula moves with the humerus, if passive movements are at all extensive. There is still some rotation forward of the humerus when the arm is held at rest, so that the external condyle presents rather more forward than in the normal arm. The boy can now touch the back of his ear and neck on the left side. He can put his hand to his mouth, which he could not do before, and he can clasp his hands behind

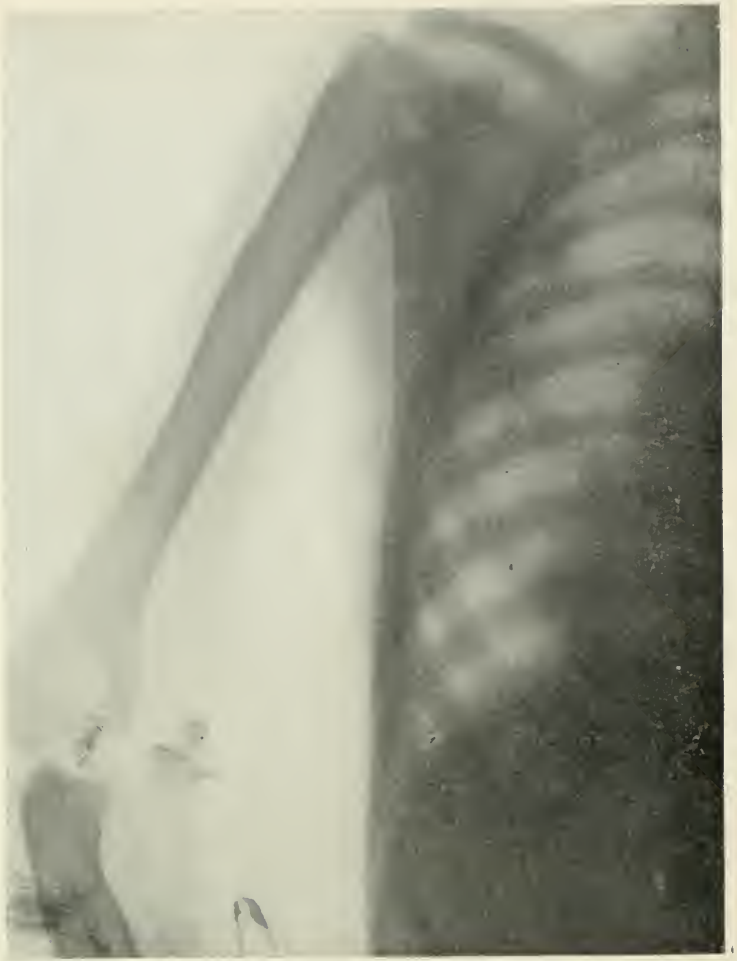
FIG. 3.

FIG. 4.

Congenital subacromial dislocation of left humerus. Same patient as Fig. 1.

Photograph taken about eighteen months after excision of head of the humerus. Observe improved position of elbow, but the shortening of humerus.

*a*. Belly of biceps unnaturally prominent because origin of one head is lost.



Congenital subacromial dislocation of left humerus. Same patient as Fig. 1.

FIG. 5.—Observe abduction and rotation of humerus, shown by the elbow being held away from the thorax, with olecranon pointing outward.

FIG. 6.—Skiagraph taken about three months after excision of the head of the humerus. Observe the absence of the abnormal rotation of the humerus, which is seen in the skiagraph taken before operation. The abduction of the humerus seen here is voluntary.

his back in the lumbar region. The normal arm from the acromion to the external condyle is six and one-half inches long. The left arm from acromion to external condyle measures five and three-fourths inches. The belly of the biceps stands out prominently in the middle of the arm. This is due largely to the division of its long head at the operation. The forearm is somewhat atrophic, and the left hand seems slightly smaller. (Fig. 5.)

He cannot lift the left hand over his head, but he can nearly touch the occipital region. He uses the right hand to lift the left arm when he desires to put the left hand on top of his head. (Fig. 6.)

His general health is good and the scapular muscles seem about as well developed as on the other side. The deltoid seems to be a little more prominent than on the other side.

It is doubtful whether he can voluntarily bring the left elbow in contact with his ribs, but he can put the left hand on the right shoulder and bring the elbow and humerus close to the ribs. It is difficult to determine the exact amount of adduction, because of the youthfulness of the child and the difficulty of making him understand.

The deformity, of which this case is an illustration, is unusual. There has been considerable discussion as to how many of such cases are traumatic dislocations caused by injuries at the time of delivery. I see no reason to doubt that a large proportion of them are the result of intrauterine conditions. Accidental subspinous or subacromial luxations are so rare in both adults and children that it seems to me reasonable to look upon them, when found immediately after birth, as true congenital conditions. It is true that violence during delivery may cause the lesion, and also that such displacements may be the result of a muscular paralysis, occurring before birth or during delivery. It is quite possible, therefore, that some of the cases reported belong to these groups. The occurrence of this posterior dislocation, occasionally in both shoulders of the same infant and at times in more than one child of the same family, is strong evidence, in my opinion, of the prenatal origin of the bony abnormality. I have not been able to

find many cases recorded in the literature which bear rigid analysis. Stimson says that he has seen 4 or possibly 5 cases; Phelps had seen, according to Stimson,[1] 6 or 7; Scudder[2] reports 2; Küster,[3] a bilateral case; Gaillard,[4] 1; R. W. Smith,[5] 1 bilateral case; Cumston,[6] 1; Peckham,[7] 2; and I reported a previous case ten years ago to this Association.

1. Fractures and Dislocations. Ed. 1905, p. 606.

2. Archives of Pediatrics, 1890, vii. p. 260.

3. Ein Chirurgisches Triennium, 1882, 256; also in Berlin. klin. Woch., January 6, 1879, i. 9.

4. Mém. de l'Acad. de méd., 1841, 703. Quoted in full by Alph. Robert, in Des Vices Congénitaux de Conformation des Articulations. Paris, 1851, p. 53.

5. An Essay upon the Original or Congenital Luxations of the Upper Extremity of the Humerus, Dublin Medical Journal, 1839, vol. xv. 249; also mentions case in his Treatise on Fractures. Dublin, 1854, p. 256.

6. American Journal of the Medical Sciences, June, 1903.

7. American Journal of Orthopædic Surgery, April, 1905, vol. ii. p. 386.

# NON-PARASITIC CYSTS OF THE SPLEEN.

By CHARLES A. POWERS, M.D.,
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Our knowledge of this subject has a twofold origin: first, the few and comparatively recent clinical reports; and second, the somewhat more numerous accidental autopsy findings. The results of these two sources of information do not seem to agree, and, as will be seen later, it by no means follows that the two are intimately related, for the discovery *postmortem* of a number of small, latent cystic formations in a spleen does not seem to necessarily bear on the fact that in certain rare cases patients suffer during life with a formidable hæmatoma, which originates in the spleen and demands surgical relief.

Up to 1904 the subject was practically ignored by writers, but that year witnessed the publication of not less than three monographic articles, each written in ignorance of the efforts of the other authors. These articles are by Heinricius,[1] Monnier,[2] and Laspeyres.[3] Heinricius' article is the most comprehensive, as it deals with both clinical and autopsy material. Monnier's paper has to do only with splenectomy cases. Laspeyres devotes a section to the latter in a monographic article on splenectomy in general. The writer presents the subject at this time, first, because he has notes of an unreported personal case; and second, because, so far as he knows, the matter has not yet received attention in English or American literature. In addition to the author's case, 2 others are added which seem to have been overlooked by other

[1] Arch. f. klin. Chirurgie, 1904, vol. lxxii. p. 138.
[2] Beiträge z. klin. Chirurgie, vol. xli.
[3] Centralblatt, f. d. Grenzgeb. d. Med. u. Chir., 1904.

writers, the total being 32. This number by no means represents the frequency of the disease, for Heinricius cites numerous bare statistics of splenectomies in various clinics which show that this operation has been done a number of times for non-parasitic cysts, although no details are forthcoming. Of the chance autopsy findings collected by the same author possibly half a dozen were large unilocular hæmatomata, which, for some reason, never came to operation. So we may assume that from fifty to sixty of these large cysts have been known to exist; this number might perhaps be increased by correspondence. However, the condition

Author's case of hemorrhagic cyst of spleen. A male of eighteen years.

is at best rare, and it may have lost some of its clinical interest from the conclusion reached by authors that it merely represents an indication for splenectomy, an operation the safety of which improves steadily from year to year.

In this paper the author will first relate his own case, and then append a brief table of 31 other observations, endeavoring to analyze these as they stand.

*Author's Case.* In September, 1895, Dr. H. M. Ogilbee, of Manitou, Colorado, kindly referred a young man of eighteen years, who presented a large, right-sided, abdominal cyst. (See figure.)

The mass was of four years' growth; there had been gradual loss of flesh and strength, anorexia, headache, and general pressure symptoms. Fluctuation was plain. The diagnosis of splenic cyst seemed positive.

*Operation.* St. Luke's Hospital. A free incision was made over the prominent part of the tumor, the walls of which were found to be about one-half of an inch thick, semicartilaginous, and solidly adherent to all adjacent structures. Extirpation seemed impossible (later autopsy findings confirmed this). The single cyst held several litres. Posterior incision; through drainage.

The walls of the cyst did not collapse, and the patient died of septic absorption from the cyst wall on the twelfth day. Autopsy, with microscopic examination by Dr. H. C. Crouch, Professor of Pathology in the University of Colorado. Anatomical diagnosis, hemorrhagic cyst of spleen. From the autopsy findings the author could not see, as said, how the cyst could have been successfully extirpated.

TABLE OF CASES.

| No. | Operator and reference. | Sex and age. | Clinical history. | Symptoms. | Treatment. | Result. | Character of cyst. |
|---|---|---|---|---|---|---|---|
| 1 | Pean. Des tumeurs de la abdomen, 1880, tome i. | F. 7 | ..... | ..... | First recorded operat'n (1843), opening with caustic and injection of iodine. | Death from peritonitis two months later. | Serosanguineous cyst. |
| 2 | Pean. Ibid. | F. 20 | Swelling and pain for two years with recent exacerbation. | Fixed, very painful tumor, fluctuating in places; diagnosis of ovarian cyst. | Second recorded operation (1867); laparotomy followed by recognition of splenic cyst, which having a pedicle was readily extirpated after emptying it by puncture and dividing its adhesions. | Recovery; patient in good health twelve years later. | Trabecular cyst, springing from spleen, capacity 3 litres, contents hemorrhagic. |
| 3 | Pean. Ibid. | F. 54 | ..... | Diagnosis of abdominal cyst. | Operation (1879), opening with caustic followed by incision. | Death in a few days, peritonitis. | Serosanguineous cyst. |
| 4 | Marano and Féréal. Progrès méd., 1874, p. 262. | M. 38 | ..... | Diagnosis of malaria with abdominal cyst. | Third recorded operation (1874), opening with caustic followed by puncture and use of retention canula. | Recovery with persistence of small fistula three months later. | Serosanguineous cyst. |
| 5 | Credé Arch. f. klin. Chirurgie, 1883, Bd. xxviii. p. 401. | M. 44 | Tumor noticed first one year ago; enlarged slowly, latterly more rapidly. | Tumor size of child's head, slightly tender, fluctuating; pedicle to left and above, covered by omentum and intestines; diagnosis, hydronephrosis or cyst of spleen. | Laparotomy (Sept. 25, 1881), isolation of tumor and evacuation by puncture; pedicle very short; spleen adherent; splenectomy pedicle buried, wound closed. | Recovery complete after 10½ months. | Cyst grew from lower half of spleen, contained 1350 c.c. yellow fluid, but slightly albuminous. |
| 6 | Thornton. Medico-Chir. Trans., 1886, vol. lix. p. 407. | F. 19 | First noticed two years ago. | Movable fluctuating mass. | Laparotomy (1884) and recognition of cyst of spleen; adhesions divided and spleen extirpated. | Recovery. | One large and several smaller cysts; serosanguineous. |

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| 7 | Spencer Wells. Brit. Med. Jour., 1889, vol. ii. p. 66. | F. 21 | Malarial splenomegaly since childhood; two years ago tumor noted in ovarian region; subsequent pregnancy (normal) followed by increase in size of tumor and secondary peritonitis. | As suggested by foregoing, exploratory puncture; evacuation of 5 litres bloody fluid; rapid reappearance. | Laparotomy (May 17, 1888), cyst ruptured and four or five litres fluid escaped; numerous splenic adhesions detached; resection cyst wall in part; drainage. | Recovery one year later patient well. | |
| 8 | Fink. Zeit. f. Heilkunde, 1890, Bd. x. p. 353. | M. 14 | Rapidly growing tumor of left upper abdominal region. | Tumor extending from ribs to hand's breadth below navel, nodular, soft, elastic, fluctuating, mobile; diagnosis of splenic cyst. | Laparotomy (Nov. 10, 1888); tumor size of child's head occupying lower left half of otherwise normal spleen resected with thermocautery. | Recovery; patient well six months later. | Serosanguineous cyst of 1500 c.c. capacity. |
| 9 | Bardenheuer. Deutsch. med. Wochenschrift, 1890, No. 36. | F. 47 | ..... | Tumor size of child's head, adherent to lesser pelvis; pain in left side abdomen; notable digestive disturbances. | Laparotomy and extirpation of splenic cyst. | Recovery. | Cystic contents thin and of a dirty chocolate-brown color; cyst walls fibrous. |
| 10 | Terrier. Bull. et mém. Soc. de chirurgie, 1892, p. 661. | F. 33 | First noticed pain in left side, followed by appearance of tumor. | Tumor level of umbilicus, size fist, freely movable, with pedicle; diagnosis, cyst of omentum or spleen, probably hydatid. | Laparotomy (Nov. 16, 1891); recognition of splenic cyst, which was punctured, then extirpated. | Recovery one year later, spleen slightly enlarged and tender. | Cyst grew from concavity of spleen; contained blood. |
| 11 | Schalita Arch. f. klin. Chir., 1895, Bd. xlix. p. 629. | F. 36 | Ill for past two years; tumor noticed five months ago; pressure symptoms. | Smooth, painless, fluctuating mass; movable below, absence of hydatid thrill or friction murmur; diagnosis of hydatid or splenic cyst. | Laparotomy; extensive adhesions of spleen after evacuation of 8 litres of fluid; division of many adhesions. | Recovery complete. | Spleen nearly transformed into a large serosanguineous cyst. |
| 12 | Moreschi and Ghetti Gaz. degli ospad., 1896, No. 119. | F. 42 | Direct violence, followed by painful swelling, increasing rapidly in size. | Examined a month after supervention of symptoms; diagnosis of enlarged and floating spleen. | Laparotomy (Aug. 14, 1896); splenectomy after division of adhesions with colon. | Recovery. | Serosanguineous cyst on anterior surface of spleen. |
| 13 | Baccelli. Journ. Policlinico, 1897, No. 6. | F. 27 | Direct violence; two months later tumor noted in left hypochondrium slowly increasing in size. | Smooth, soft, elastic, and fluctuating mass attached to lower border of spleen; movable and but little sensitive. | Tumor twice punctured with escape of pure blood; did not refill. | Recovery one month later, small swelling still perceptible. | Probably subcapsular hemorrhage of slow development, which disappeared when outlet was furnished. |

| No. | Operator and reference. | Sex and age. | Clinical history. | Symptoms. | Treatment. | Result. | Character of cyst. |
|---|---|---|---|---|---|---|---|
| 14 | Henetaux. Bull. et mém. Soc. Chir., Paris, 1898, p. 928. | F. 27 | One year ago noticed tumor which steadily increased in size. | Large fluctuating mass occupying three-fourths abdominal cavity. | Laparotomy; cyst incised and washed out, then marsupialized. | Suppuration for a year; injection iodine, etc.; recovery after lumbar counter opening and drainage. | Capacity of cyst 10 litres; contents bloody chocolate-colored fluid. |
| 15 | Baginsky. Berl. klin. Wochen., 1898, No. 2. | F. 12 | Swelling of left side shortly after violent fall. | In left hypochondrium an elastic fluctuating mass extending across median line; exploratory puncture; diagnosis of hemorrhagic cyst of spleen. | Operation (May 3, 1896) by Prof. Glück; cyst sutured to perineum and skin; an elliptical piece excised from cyst wall; evacuation of 2 litres fluid; cyst cavity tamponed. | Recovery; radical cure in sixteen weeks. | Excised piece of cyst wall showed some normal splenic tissue. |
| 16 | Machailowsky. XII. Internat. Congrès, Paris, 1900. | ... | Malarial splenomegaly; trauma. | Traumatic blood cyst of spleen. | Splenectomy. | Recovery. | |
| 17 | Subbotic. Deut. Zeit. f. Chir., 1900, Bd. liv. p. 487. | F. 40 | ..... | Malarial splenomegaly, perisplenitis; floating spleen. | Splenectomy for splenomegaly (1897). | Recovery. | Spleen also seat of small multiple cysts, some serous, some hemorrhagic. |
| 18 | Subbotic. Ibid. | M. 30 | ..... | Tumor size of man's fist beneath left costal arch: diagnosis, echinococcus or blood cyst of spleen. | Operation of incision and drainage (1892); parietal peritoneum adhesive to wall of tumor; evacuation of 1500 c.c. of bloody fluid and clots, peritoneum not opened. | Recovery, with small fistula. | Hemorrhagic perisplenic cyst from subcapsular hemorrhage; eventual adherence to peritoneum. |
| 19 | Subbotic. Ibid. | F. 21 | ..... | Tumor larger than man's fist, beneath left costal arch; adherent to peritoneum. | Incision and drainage (1887); escape 2 litres bloody fluid, clots also in cyst. | Recovery. | Hemorrhagic perisplenic cyst; correct diagnosis before operation. |

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| 20 | Subbotic. Ibid. | F. 30 | ..... | Diagnosis of chronic splenomegaly with lymphatic cyst at hilus of spleen. | Splenectomy (1898). | Recovery. | Cyst size of hen's egg close to pedicle of spleen; cavity traversed by septa; walls continuous with splenic capsule. |
| 21 | Leonté. Cited by Heinricius (see No. 29). | F. 55 | ..... | Tumor in pit of stomach; diagnosis, cyst of gastro-splenic ligament. | Splenectomy; lesion found to be unilocular cyst of spleen with almost complete atrophy of latter. | ? | |
| 22 | Reimann. Ueber milecystein Diss. Leipzig, 1901. | M. 33 | ..... | Spleen enlarged and irregular in form and consistence; pressure symptoms upward; trial puncture brought away old hemorrhagic fluid. | Operative puncture at repeated intervals; no improvement; radical operation refused. | No benefit. | Serosanguineous cyst. |
| 23 | Routier. XIV. Congrès de Chirurg., Paris, 1901, p. 157. | F. 21 | Tumor first noted nine years ago; gradually increased in size, one year ago began to grow more rapidly. | Resembled floating spleen until after rapid increase. | Splenectomy (Feb. 15, 1901). | Recovery. | Splenic tumor occupied lower half of organ, upper part being normal; composed of multiple organized hæmatomata. |
| 24 | Lejars. Ibid., p. 158. | F. 43 | Tumor first noted about a year before; previous history of trauma and severe abdominal disturbances extending over months. | Tumor in splenic area tapped from behind and in front with evacuation of old hemorrhagic fluid; supervention of symptoms of infection led to intervention. | Operative lumbar incision (Jan. 3, 1901); escape of $1\frac{1}{2}$ litres dark, bloody fluid; sac washed out drained; extended to iliac crest, lumbar region, and navel. | Recovery. | Probable subcapsular hemorrhage of spleen with resulting perisplenitis. |
| 25 | Dalinger. Med. Obosreuija, Dei, 1901. | M. 44 | Malaria for a year with very recent acute exacerbation; confined to bed; collapse. | High temperature; increased splenic dulness. | Splenectomy. | Recovery. | Subcapsular hemorrhage of spleen, capsular adhesions; splenic tissue soften'd; blood partly liquid and partly clotted; was present in cyst. |
| 26 | Chaviér. Bull. méd., 1902, tome xvi. p. 24. | M. | Many years before had a hurt over spleen; subsequent digestive disturbance; recent acute exacerbation; violent pains; tympanitis. | Diagnosis of intestinal occlusion. | No operation. | Death in two days. | Autopsy showed tumor over spleen, non-adherent; represented by subcapsular hæmatoma, with consecutive atrophy of spleen; tumor much longer than spleen; death from ruptured stomach. |

| No. | Operator and reference. | Sex and age. | Clinical history. | Symptoms | Treatment. | Result. | Character of cyst. |
|---|---|---|---|---|---|---|---|
| 27 | Jordan. Central. f. Chirurgie, 1903, No. 36. | F. 46 | ..... ..... | ..... | Splenectomy. | Recovery. | Blood cyst of spleen. |
| 28 | Monnier. Beit. z. klin. Chir., 1903–1904, Bd. xli. p. 181. | F. 21 | Recently, with good previous history, local and general symptoms and beginning of tumor in left hypochondrium. | Bulging in left hypochondrium; tumor moved on respiration with rough friction murmur; appeared to be a cyst, not tender and somewhat movable. | Operation (June 12, 1903, Prof. Kronlein); cyst of upper part of spleen; adherent to surrounding tissues; puncture brought away bloody fluid; splenectomy after division of adhesions. | Recovery. | Capacity of cyst 3½ litres. |
| 29 | Heinricius. Arch. f. klin. Chirurg., 1904, Bd. lxxii. p.138. | F. 14 | Tumor noted shortly before operation; general health good. | Mass reached nearly to pubes; smooth tense; freely movable; uterus and ovaries normal. | Operation (May 21, 1900); spleen found displaced downward and twisted on pedicle, with tumor growing from outer portion; splenectomy. | Recovery; patient well three years later. | Splenic tumor cystic, capacity 800 c.c., size child's head; contents hemorrhagic; grew from outer lower portion. |
| 30 | Powers. | M. 18 | Tumor had been growing for four years. | General failure of health; pressure symptoms. | Operation (Sept. 1895); incision, tumor universally adherent; freely opened, evacuated, and drained; walls were thick and semi-cartilaginous and did not collapse. | Death on twelfth day from sepsis due to absorption from cyst walls. | Unilocular cyst. |
| 31<br>32 | Leonté. XIV. Congrès Chir., Paris, 1901. | F.<br>F. | .....<br>..... | .....<br>..... | Both cases operated on by marsupialization. | Both recovered | Both unilocular, serosanguineous cysts of spleen, capacity 1400 to 2000 c.c. |

*Brief Analysis of Thirty-two Tabulated Cases.*

Etiology. These 32 cases represent the known clinical material which has been under observation during life. In all but 1 (Michailousky) the sex is given—viz., male, 8; female, 23. In 21 female cases the ages are given, and we learn that the very great majority (18) occurred during the menstrual years; at least 16 in the child-bearing period. Making due allowance for the influence of injuries and diseases of the spleen, and for the fact that in some instances the cysts were a long time in developing, there seems no reason to doubt that these occur often enough in women during the reproductive cycle to give the affection a gynecological bias. If we study the cases discovered in chance autopsies, the data, while scanty, do not appear to show this; so that we are, perhaps, justified in regarding menstruation and parturition as merely aggravating causes. In a few instances the cyst became much enlarged by childbirth, and perhaps full particulars of the history, which details are often wanting, would increase the number.

Aside from the teachings furnished by sex and age, the meagreness of many case histories renders further data as to causation of limited significance. Traumatism and antecedent disease of the spleen (especially malarial enlargement) undoubtedly act as contributory causes in not a few cases; in as many others, however, such factors are wanting. Whatever the original cause, we often find recorded an acute exacerbation which brings the patient under medical observation. Aside from childbirth, we know nothing of the causes of such exacerbations.

Symptoms. After the cases came under medical observation the cystic character of the tumor seems to have been generally recognized, although in a few cases the diagnosis, rightfully or wrongfully made, of an enlarged or floating spleen is recorded.

Diagnosis. The precise diagnosis, both as to origin and character of the cyst, was seldom made, although in some cases it was recorded as a possibility; that is, it was noted as one member of an alternative.

Differential Diagnosis. We find among the recorded diagnoses abdominal cyst (without going further), ovarian cyst, hydro-

nephrosis, cyst of the omentum, cyst of gastrosplenic ligament, hydatids, ileus, and, as before stated, enlarged or floating spleen; in a few instances the correct diagnosis was made.

TREATMENT. When we come to treatment we find that of the 32 cases 1 died of intercurrent rupture of the stomach before operation could take place (Chavier). In 2 of Subbotic's cases the spleen was really removed for chronic hypertrophy, and the discovery of complicating cystic formations was simply accidental. Finally, in 1 of Leonté's cases (No. 21), not accessible at first hand, the reviewer (Heinricius) omits to state the result of the operation (splenectomy), although we have every reason to believe that it was successful. This leaves 28 cases for consideration. Analyzing these, we find that the patients have been treated as follows: simple puncture, 3; incision and injection, 2; incision and drainage, 5; marsupialization, 3; extirpation of cyst, 5; extirpation of spleen, 10.

*Puncture.* Of the 3 cases of puncture (Marcano and Féréal, Case 4; Baccelli, Case 13; Reimann, Case 22), in the first of which a retention cannula was used, 2 patients made a relative recovery. In 1 a fistula remained, and in another complete resolution did not occur. The third was merely a case of palliative tapping, and no improvement resulted.

*Incision (and Injection).* The 2 cases (Cases 1 and 3) thus treated were among the earliest recorded (Pean). Both patients died of peritonitis; the first after a course of iodine injections; the second soon after incision, probably anticipating injection treatment.

*Incision and Drainage.* (This method includes tamponade). Of 5 cases (Cases 15, 18, 19, 24, and 30) thus treated 3 made complete recovery and a fourth a relative recovery (persistence of small fistula). The fifth patient (author's case) died of sepsis.

*Marsupialization.* Three cases (Cases 14, 31, and 32) treated in this manner made good recoveries.

*Resection of Cyst.* This operation was performed five times (Cases 2, 7, 8, 9, and 10) and varied with the nature of the cyst. If a pedicle was present, the latter was readily tied off. Otherwise

the extirpation was effected as thoroughly as practicable. It is worthy of note that all of these operations were done at an early date (none subsequent to 1892). Four patients made complete recovery. The fifth, Terrier's case, made a relative recovery, the spleen being slightly enlarged and tender a year after operation.

*Splenectomy.* There were 10 cases (Cases 5, 6, 11, 12, 16, 23, 25, 27, 28, and 29) of this operation (we do not include 2 cases of splenectomy by Subbotic, in which the operation was really done for chronic enlargement), and all recovered.

A comparison of these methods appears to show that puncture, incision, and drainage, and resection of the cyst proper, while able to secure permanent recovery in selected cases, are nevertheless untrustworthy, each having failed (in a part of a small series of cases) to produce cure, while several fatalities have resulted. Although marsupialization has a clean record in a small number of cases, it is manifestly restricted to those in which the integrity of the spleen is not compromised. On the other hand, splenectomy appears to be the only operation of general applicability, and to be a necessity whenever the spleen is extensively affected, either by pre-existing disease or by displacement, or by atrophy due to the compression of large cysts, etc. We must bear in mind that the conservative operations are, as a rule, of relatively earlier date than the radical, and were employed largely in the thought that total ablation was fraught with great danger to the system at large. Those who first removed the spleen for this condition seem to have been very anxious as to the state of the blood count, thyroid, and bone-marrow.

Pathology and Nature. Not very much is to be learned from an analysis of the clinical material as to the actual nature of these cysts, most of the speculation as to the origin and development of the formations being based upon autopsy cases, in which the cysts are small and latent. As has been observed, it is a long distance from the latter findings to cysts of surgical importance, and it is difficult to show a direct transition from the one to the other. Indeed they may represent two entirely independent conditions. The autopsy cyst is of common occurrence—one

pathologist may encounter many cases in a lifetime. The clinically important cyst, on the contrary, is very rare, and few surgeons meet more than one or two in an entire experience.

Clinical observations, however, teach us these truths: nearly all of the cysts which come to treatment are large and unilocular, and of the serosanguineous type. They contain from one to ten litres of fresh or old blood, and the greater the age of the cyst, the greater the amount of secondary alterations, resulting from absorption of the fluid portion, decomposition of coloring matter, and persistence of organized fibrin, cholesterin, mineral matter, etc. The walls of the cyst consist of a varying proportion of splenic and fibrous tissue, with corresponding variations in thickness.

Without going into speculation, based upon histological studies of small cysts found accidentally at autopsy, it seems safe to say that the typical cyst of the spleen, from the purely surgical standpoint, originates in a subcapsular hemorrhage of whatsoever origin. This is especially true of the cases reported during the last ten or twelve years. We find a concensus of data which shows that the slight, continuous escape of blood beneath the capsule, never severe enough to present symptoms of internal hemorrhage, causes a hæmatoma; and that the peritoneal capsule undergoes a low form of inflammation which almost invariably results in adhesion to the outlying tissues. If the tumor is of sufficient size, pressure symptoms result, which may affect the thorax or abdomen, according to locality. If the peritoneal reaction is sufficiently intense, pain, vomiting, etc., may come on. If the pressure is exerted upon the spleen itself, the organ undergoes atrophy in time.

But although this seems to be the predominant form of splenic cyst, and one which is very sharply characterized, it by no means represents all the possibilities of the lesion. There are other cases in which the hemorrhage cannot be regarded as subcapsular, but must be thought parenchymatous. The former has a free field in burrowing between the spleen and its capsule, in accumulating in large amounts, and in causing perisplenic adhesions and pressure symptoms. The latter is deeper seated, smaller, and more localized, originating probably from rupture of a splenic bloodvessel. Its

walls are composed originally of normal splenic tissue, which in time becomes transformed in part into simple fibrous tissue. While it tends to come to the surface of the spleen, the pressure symptoms and the peritoneal adhesions are much less in evidence. The difference between the two types is essentially one of degree. The contents of these cysts are the same, and under certain circumstances the two may produce in time the same clinical picture. Generally speaking, however, the parenchymatous variety is more strictly isolated and is localized in a particular region of the spleen, the remainder of the organ being intact. It has even happened that these cysts have formed pedicles, or have developed sessile attachments to a spleen otherwise normal. Hence it is not surprising, bearing in mind the former fear of extirpating the entire spleen, that the earlier operators employed conservative measures in dealing with these cysts, especially when they were clearly circumscribed. Nor can we, even at this time, deny that such sharply localized cysts are best treated conservatively in selected cases, especially when the cyst is pedunculated.

Non-hemorrhagic cysts are of such rare occurrence clinically that they may be left out of consideration.

Some of the more recent writers, in view of the frequent complication of perisplenitis, are calling attention to the diagnostic value of a perisplenitic friction sound, which is synchronous with respiration. Such diagnostic evidence, while obtainable in certain cases, seems to the writer to border on the fanciful.

Heinricius states that the hæmatoma is readily distinguished from all other cysts as to origin and nature. It must be due either to rupture of a healthy vessel by trauma, or of a diseased vessel, either spontaneous or traumatic. Probably as a result of the study of autopsy material, he adds that such ruptures may occur in connection with tumor formation (doubtless meaning angiomata). These blood cysts differ nowise from hæmatomata in other localities. Heinricius appears to have overlooked the fact that the typical hæmatoma is subperitoneal or subcapsular, with an almost inevitable tendency to cause adhesions; at least, he speaks of the process as though it were essentially intrasplenic.

In regard to the evolution and symptoms of large cysts, Heinricius states that they most often grow in the direction of least resistance—*i. e.*, downward and forward—yet he admits that in some cases the pressure is exerted toward the diaphragm. The relation of the growing cyst to the surrounding viscera and to local and general symptoms is not explained. Generally speaking, the tumor is of irregular contour, fluctuating in places, and rather insensitive. The rate of growth may be very variable. His statement that the cysts may rupture or suppurate does not seem to be borne out by facts.

Diagnosis must, as a rule, be made by exclusion alone. In addition to sources of confusion already cited, pleural effusion, cyst of the right lobe of the liver, and abscess of the abdominal wall may be added.

The patient's account of his own case possesses considerable value. Exploratory puncture can throw but little light on the origin of the tumor.

The operation almost invariably indicated is splenectomy, which is only contraindicated by extensive adhesions and extreme cachexia. Extirpation of the cyst is practicable only when a pedicle is present. Other interventions are condemned. They are essentially palliative and, moreover, dangerous.

Monnier explains the predominance of female patients in the reproductive cycle by the fact that the spleen becomes hyperæmic and relaxes during menstruation, pregnancy, and the menopause. He thinks small, latent cysts may become hemorrhagic, but admits that no one has demonstrated a connecting link between them and the large hæmatomata. The blood count is of no value in diagnosis, since it undergoes no change. He is inclined to believe that the perisplenitic friction sound has a limited diagnostic value, even if it only serves to exclude the possibility of extraperitoneal tumors.

# REMOVAL OF ENTIRE BLADDER FOR CARCINOMA.

By N. B. CARSON, M.D.,
ST. LOUIS.

P. B., Canadian, aged forty-nine years; married; carpenter. Consulted me first in my office more than a year before he entered the hospital on account of frequent and painful urination. At times there was more or less blood present. At that time had also lost weight. I advised that he enter the hospital for examination and observation, suspecting from the history given that he had cancer of the bladder. On June 5th he sent me some of his urine in which were two fragments of the tumor nearly as large as the end of the little finger, besides a number of smaller pieces. These were found to be carcinomatous. On June 7th he entered the hospital and the following history was obtained:

*Family History.* Cause of death of father and mother unknown. No history of tubercle in the family. Of the ten brothers and sisters two died from tumors.

*Previous History.* Had never had any serious sickness except one. About twenty-five years ago was operated upon for stone in the bladder. Habits fairly good.

*Present Condition.* About two years ago noticed a frequent desire to urinate, which was more or less painful at times, and this condition gradually increased. Over a year ago first noticed blood, which at times was of considerable quantity. Several months before entering the hospital pieces of "flesh" commenced to pass, and he also commenced to suffer from incontinence, especially at night. At this time the urine was very "dirty" and offensive and at times almost pure blood.

*Physical Examination.* White, male, brunette, well developed and muscular. Poor teeth. Chest and abdominal organs healthy.

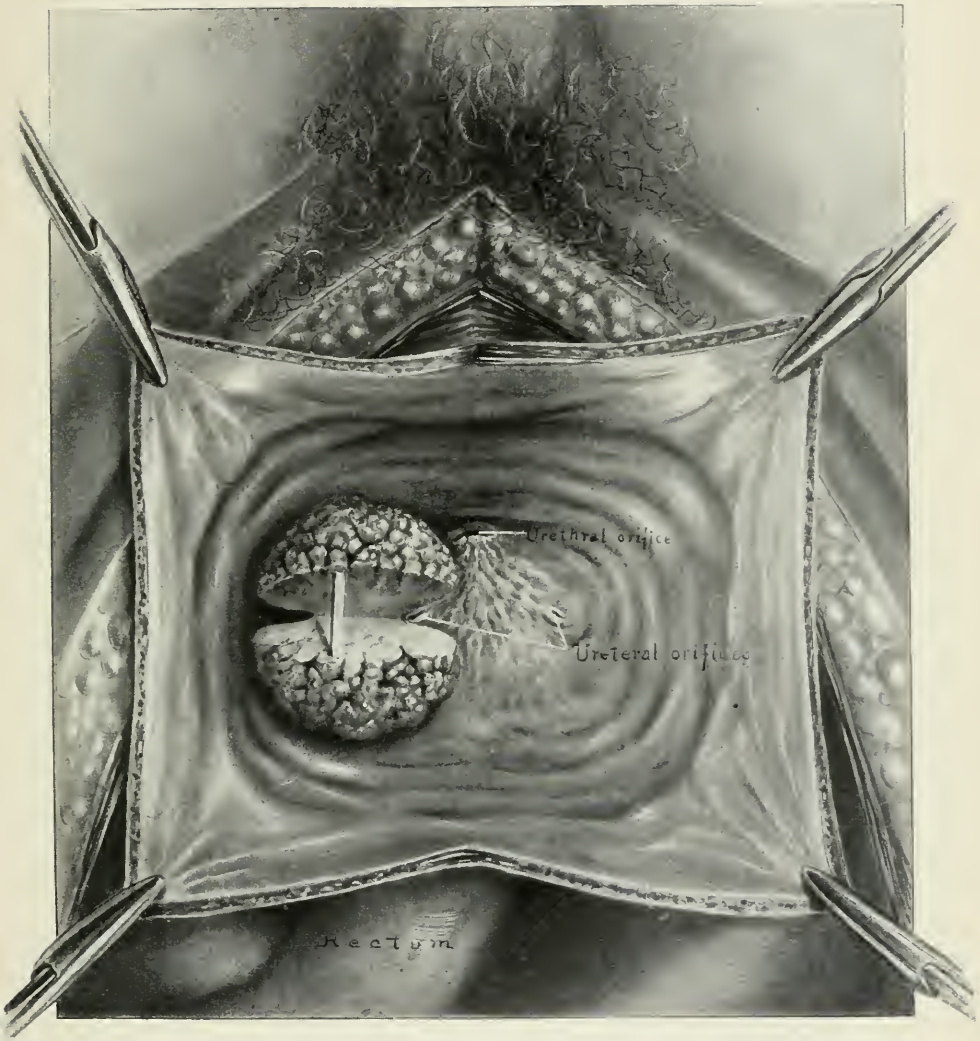
Rectal examination negative. Cystoscopic examination failure on account of blood.

*Urine Examination.* Specific gravity 1025, amount negative, color very cloudy, reaction slightly acid, sediment heavy, whitish particles. Albumin, 5.1 per cent.; sugar, none.

*Microscopic Examination.* Mucous shreds, red blood corpuscles, pus cells, no casts. Microscopic examination of fragments from bladder showed papillary carcinoma, which finding was confirmed later by examination of section from tumor after removal.

On June 11th suprapubic cystotomy was done and a tumor as large around as a silver dollar, of mushroom shape with a base as large as a half-dollar, was removed from outer and upper border of the left ureter with scissors and curette. Base involved only mucous and muscular coats, with only a moderate amount of infiltration. The mucous membrane and infiltrated tissue were freely removed. There was not much bleeding and what there was was easily controlled by hot water.

After the operation the urine changed very little, becoming somewhat clearer; this, however, was to be expected. The bladder was washed out several times daily with warm boric acid solution and the patient was encouraged to sit up as much as possible, but for this he was little inclined. He seemed to progress favorably until the fourth day, when he had a free hemorrhage from the bladder and an examination showed a recrudescence of the growth. A complete removal of the bladder was then advised. To this he readily assented and the operation was done on June 27, 1904. The suprapubic incision was extended upward and the right side of the rectus muscle was freed from the pubis. This gave plenty of room for the subsequent steps of the operation. Commencing above, the peritoneum was stripped from the bladder wall without much difficulty and with little hemorrhage, by means of the fingers and scissors. When the neighborhood of the ureters was reached catheters were introduced into them and the dissection continued until we came to the catheterized ureters, which were divided around the catheters. A ligature was then passed through each ureter and the dissection continued to the prostate, where the


Urethral orifice
Ureteral orifices
Rectum

bladder was divided and removed, leaving the prostate undisturbed. The rectum was then thoroughly cleansed and a long dressing forceps introduced into the rectum and made to press firmly against the anterior rectal wall, first on one side and then on the other, and the walls were button-holed and the ureters seized and drawn into the bowel on their respective sides with the ligatures, which were brought out through the anus and tied to a safety pin.

The ureters were not sutured to the rectum; in this step of the operation I made a mistake, as we will see later. The ureters should have been sutured to the rectum. A drain was introduced into the wound and a dressing applied which was changed many times a day. In spite of all precautions the wound became infected, partly on account of the patient and partly on account of the nurse entrusted to care for him. The operation required an hour and a half and was well borne by the patient. The main features of the operation were the ease with which the bladder was separated from the peritoneum and the small amount of blood lost, not a ligature having been applied.

The patient rested well after the operation and urine was discharged for two days entirely through the rectum. On the third day part of the urine came from the bowel and part from the wound, showing that the ureters had escaped from the bowel and discharged in the wound, forming eventually an artificial bladder which would hold two or three ounces of urine, and when the abdominal fistula which remained after the closure of the suprapubic wound would become stopped up from any cause, could be discharged with considerable force by the action of the abdominal muscles. On the tenth day after the operation he complained of pain in the left groin, which was accompanied with a slight rise of temperature. On the fourteenth day a sausage-shaped tumor about an inch and a half wide by four inches in length appeared. The urine, which had changed little after operation, showed an increase of pus. The tumor remained unchanged until after the twentieth day; then after a discharge of a considerable quantity of pure pus it almost entirely disappeared, only to return again at intervals.

This tumor did not seem to be connected directly with the ureter. He would not consent to have it opened. The patient was gotten out of bed on the seventh day and out on the porch in a rolling chair at the end of two weeks, but on account of the constant discharge of urine from the wound it was with difficulty that he could be induced to leave his bed. He was altogether a hard patient to handle and not at all inclined to help himself in any way, which under the circumstances made it almost impossible to keep him clean. After leaving the hospital he kept to his bed for the greater part of the time and could not be induced to leave his home, although he could have done so with benefit. On the fortieth night after the operation he had an erection of the penis with a seminal emission, showing that the seminal vesicles had not been injured.

The total extirpation of the bladder has, according to Hartley, been performed twenty-three times with eleven deaths and twelve recoveries. Since Hartley's paper was published there have been other cases, but for lack of time I am unable to include these in this report.

The mortality appears from this report to be so large that the operation does not seem to be justifiable, but from a review of the cases I am inclined to think that in most cases the kidneys were involved and death was due more to the anæsthetic than to the operation itself or to infection along the ureters. According to Hartley the ureters were differently implanted, with the rectal implantation predominating. If called upon again to do this operation I shall first do a lumbar colostomy, dividing the bowel into two segments after the method of Modlinski, converting the lower segment into an artificial bladder which can be prepared for reception of the ureters later. The rectal mucous membrane tolerates the urine without irritation and the sphincter ani controls the outlet so that the patient has perfect control of the discharge.

This method seems to me likely to afford the patient much more comfort than the formation of a new bladder at the site of the normal organ or the transplantation of the ureters to other sites.

# PATENT URACHUS.

## REVIEW OF THE CASES REPORTED. OPERATION ON A CASE COMPLICATED WITH STONES IN THE KIDNEYS. A NOTE ON TUMORS AND CYSTS OF THE URACHUS.

By GEORGE TULLY VAUGHAN, M.D.,
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Interesting surgical conditions are found in the umbilical region as a result of the imperfect development of two fetal structures, namely, the allantois and vitelline or omphalomesenteric duct. In order to understand these conditions let us glance at the embryology of the subject.

Kirke says: "The splanchnopleure, lined with hypoblast, folds in and pinches off, as it were, a portion of the yolk sac, inclosing it in the body cavity. This forms the rudiment of the alimentary canal, which ends blindly toward the head and tail,while the centre communicates freely with the cavity of the yolk sac through the canal termed *vitelline* or *omphalomesenteric*. Growing out from or near the hinder portion of the intestinal canal, with which it communicates, is the allantois."

From this it is seen that at one time both the yolk sac or umbilical vesicle and the allantois communicate by means of tubes with the alimentary canal. After a while a separation takes place in the alimentary canal; it grows longer into a tube-like formation, and the hinder portion becomes separated and is converted into the urinary bladder, which still communicates with the allantois through the navel by means of a tube known as the *urachus:* while the intestine communicates with the umbilical vesicle through a similar tube through the navel—the *vitelline duct.* Normally

both these communicating tubes become obliterated or converted into impervious cords in the process of development. Occasionally this fails to occur; then in the one case we have either a patent vitelline duct, which extends from the intestine to the navel, through which the intestinal contents may be discharged, or the vitelline duct may be obliterated partially from the navel to within one, two, or three inches of the intestine, leaving a diverticulum attached to the intestine (ileum) known as Meckel's diverticulum. In the other case we have a patent urachus; that is, a tube leading from the summit of the bladder to the navel, through which urine is discharged.

It is my purpose simply to discuss the latter condition.

In a search through the surgical literature afforded by the Army Medical Library I have found reports of 52 cases, a brief outline of which I have given.

Although Cabroll, in 1550, recognized and treated a case of patent urachus, it seems that considerable difference of opinion existed among the older anatomists as to the nature of the urachus, as to whether it was a tube or a solid cord, and if a tube, when, if ever, its lumen became obliterated. Thus Wutz, in 1883, says that for a long time there have been differences of opinion as to the nature and construction of the middle ligament of the bladder, which was said to be formed from the urachus.

Blasius, in 1674, says the urachus is sometimes pervious for a short distance from the umbilicus, and in other subjects it may be said to form a duct extending from the bladder to the umbilicus.

Littré, in 1701, says the urachus in the human fœtus easily admits a bristle.

Haller, in 1739, says there has been a dispute since the time of Harvey as to a pervious urachus and allantois in the human subject, some claiming erroneously from dissections of animals that it receives the urine from the bladder, while others deny it. Still others admitted the existence of an allantois or third membrane, but did not believe that it communicated with the bladder. He had an opportunity to examine the body of a fœtus in a woman who died in the fifth month of pregnancy, and states, as the result,

that there are really three membranes surrounding the fœtus, but that no water exists between the allantois and the amnion, and that there is no natural channel through the urachus.

Peyer, in 1741, says the urachus in the fœtus is open until the last days of pregnancy, when nature wisely closes it, differing in opinion with Bauhin, De Graaf, Meckel, and Arnold.

Böhmer, in 1764, says that he has seen the human urachus open from the bladder six and one-half thumb widths toward the navel.

Portal, in 1769, says that after all the urachus is a ligament intended for the suspension of the bladder. He describes it as containing four cords extending from the navel to the bladder, one going to each side in front and behind in the form of a "goose-foot."

Walter, in 1775, after the examination of more than 100 corpses, states that the urachus is always pervious in the fœtus, nor is it always closed in the adult.

Cruveilhier always found the urachus solid both in adults and in the fœtus, and when found pervious Bichat and most anatomists regarded it as anomalous.

Bourgeois, in 1821, presented a male fœtus, three or four months old, in which he demonstrated the continuation of the bladder by means of a canal through the navel into the umbilical vesicle.

Wutz, in 1883, after having examined 74 bodies of both sexes and different ages, concludes that in most bodies the urachus is permeable from the bladder for a short distance upward, the opening into the bladder being guarded by a valve-like fold of mucous membrane, which makes it difficult to pass a probe, and which, during life, prevents the escape of urine from the bladder into the urachus. Doran has suggested the name of "Wutz's valve" for this little fold of mucous membrane.

The patent urachus has been found in different forms, which may be included under the following headings:

1. The complete, in which the duct is open all the way, forming a continuous communication between the bladder and the outside of the body at the navel.

2. The blind internal, in which the navel remains closed, but the duct communicates with the bladder.

3. The blind external, in which the communication with the bladder is closed, but the navel end of the duct remains open.

4. The blind, in which both ends are closed, but the duct remains open in the middle.

Sometimes the bladder extends quite to the navel, the urachus being dilated into a funnel-shaped tube, with the small end attached to the umbilicus and the large end gradually enlarging into the bladder, without any point of constriction or demarcation between the urachus and bladder. Such were the cases reported by Garrigues and by Tuholske.

The *complete* patent urachus is not always congenital, as it may be acquired by the bursting open of the closed end of one of the blind varieties; in the large majority of instances it is the blind internal which is thus converted into the complete variety by rupture through the navel or by the opening of an abscess or swelling at or near the navel.

Of the 53 cases reported 46 were complete, 26 congenital, and 19 acquired (in 1 the history did not indicate the time of occurrence), 4 were blind internal, and 3 were blind external.

Obviously the diagnosis is difficult or impossible in the blind cases when both ends are closed, unless the cavity becomes distended with pus or other fluid.

Undoubtedly, in the majority of cases, the condition is one of congenital malformation or arrested development; 26 of the 53 cases were born with the condition of complete patent urachus.

According to Walter and Wutz the majority of persons have naturally the blind internal form of patent urachus. As long as Wutz's valve is competent and no urine or infection gets into the urachus no trouble occurs. When the urachus becomes distended with urine infection soon follows, with the formation of an abscess, which points at or below the navel, through which it bursts or is opened by the surgeon, or it may empty itself into the bladder, as in Hird's case (*c*).

Obstruction to the passage of urine through the urethra existed in many of the cases of acquired patent urachus, such as tumors, stone, or inflammation of the bladder, phimosis, hypertrophy of

the prostate gland, or stricture of the urethra. In some of the cases, after prolonged retention, urine suddenly bursts through the navel. (See the cases of Guisy, Lexer, and Levié.)

*Sex* is important. Of the 50 cases in which the sex was given 32 cases were males.

As to *age*, of course, in the congenital cases the condition appeared at birth, or soon after the stump of the cord separated.

Of the 24 acquired cases of all varieties the ages at which the fistula appeared varied from six months to seventy-nine years, the average age being twenty-seven years; 13 over twenty years and 11 under twenty years of age; 6 under ten; 5 between ten and twenty; 4 between twenty and thirty; 2 between thirty and forty; 1 between forty and fifty; 4 between fifty and sixty; 1 between sixty and seventy, and 1 between seventy and eighty.

Although Cabroll operated as early as 1550, there seems to have been no other operations for the relief of this condition until the nineteenth century arrived, and not infrequently the physician advised against operation.

The following are the various methods of treatment used in the cases under consideration:

1. The application of caustic or of the actual cautery to the umbilical opening. Three cases were treated in this way, with 2 recoveries and 1 death.

2. The use of the cautery and ligature or suture. Two cases were treated in this manner, and both recovered.

3. The application of ligature or suture only. Four cases were treated by this method and all recovered.

4. Plastic operation—dissecting up the skin to cover the opening. Two cases were treated thus, with 1 recovery and 1 death.

5. The urachus was slit up, curetted or cauterized, and packed. Six cases were treated this way, with 4 recoveries, 1 death, and 1 result not given.

6. Removal of irritation—such as removing stones from the urachus, keeping up drainage, and keeping the parts clean, sometimes using adhesive plaster to approximate the edges of the open-

ing. Five cases were treated in this manner, with 4 cures and 1 failure.

7. Removal of obstructions to the normal outflow of urine, as a tight prepuce, stone or tumors in the bladder, hypertrophy of the prostate gland, or stricture of the urethra. Five cases were treated in this way and all were cured.

8. Extirpation of the urachus and sewing or ligating the part next the bladder, as in excision of the vermiform appendix. Eleven cases were treated by this method, with 10 cures, and in 1 the result was not given.

9. No treatment. This includes the cases in which the patients declined treatment, the surgeon advised against operation, or no statement of treatment was given.

Some of these patients were otherwise in excellent condition without infection or excoriation, and only had the annoyance of slight leakage, while others had infected tissues, with discharge of urine and pus from the urachus and excoriation about the navel. This list includes 15 cases, with 3 deaths.

In all 38 cases were operated, with 32 recoveries, 3 deaths, and in 3 the result was not given.

The methods which have for their object closing only the umbilical end of the urachus, and possibly leaving a tube often infected, which may or may not communicate freely with the bladder, are not to be commended. The first four methods come under this classification, and include 11 cases, with 2 deaths; in 1 case, Ball's, death was due to peritonitis following rupture of the urachus and escape of urine into the peritoneal cavity.

Method 5, slitting up the cavity and packing, is a rational method, and ought to give good results; although there was 1 death from uræmia in the 6 cases thus treated, but this would probably have followed any method of operating.

Extirpation of the urachus with the entire diseased area, and closure of the opening in the bladder by sutures with union of the muscles and skin, with or without drainage, is the method of election.

Sixteen cases treated by extirpation, or by removal of obstruc-

tions to the urethra, resulted in 15 recoveries, and in 1 the result was not stated.

*Cases Reported.*

1. Case of Cabroll. The earliest case observed in the human seems to have been that of Cabroll, quoted by Lexer and Guignes, in a twenty-year-old girl, in whom all the urine passed through the navel. She was cured by ligating the protrusion at the navel and by dilating the urethra.

2. Case of Littré. Littré reported, in 1701, the case of a girl, aged twelve years, who passed urine through an opening in the umbilicus. The neck of the bladder was closed by a fleshy growth.

3. Case of Paget, 1844. In 1844 Paget reported the case of a man, aged forty years, who had passed urine through his navel since birth. He complained of frequent painful micturition, and examination revealed a stone. A catheter was made to pass through the urethra into the bladder, out through the navel. Introducing the finger through the opening in the navel it engaged in the ring-shaped calculus, which was withdrawn. The calculus had formed around a hair which was coiled like the ring and was composed of lithic acid. It was thought best not to interfere with the congenital defect.

4. Case of R. G. Cabell, 1847. In 1847 R. G. Cabell examined a mulatto girl, aged fourteen or fifteen years, in good health, with an umbilical fistula through which she had passed urine since earliest childhood, though most of it passed through the natural way, and she claimed to have the power of passing it either way at will. No treatment.

5. Case of Doran, 1851. Doran reports a case which occurred to Stanley in 1851. A boy, aged two years, had suffered several months from irritation of the bladder, and just before death a fluctuating tumor in the hypogastric region was punctured and fluid and pus evacuated. After this all the urine was discharged through this opening. Necropsy showed an abscess of the urachus and numerous small tumors in the bladder.

6. Case of Thomas Bryant, 1862. A boy, aged eight years, had

had from birth discharge of urine through the navel. The mother refused to allow any treatment to cure the condition.

7. Second case of Thomas Bryant. A man, aged thirty-five years, had a swelling extending from the umbilicus to the pubes, which he had noticed for years. The bladder seemed all right. The tumor was incised and an offensive fluid escaped, and later urine passed through it. It was packed and subsequently contracted, and the patient recovered.

8. Case of Annandale, 1869. A man, aged thirty-nine years, had passed a portion of his urine through an umbilical fistula since birth. When making water in the upright position about two-thirds would come out through the fistula, the other third coming by way of the urethra, which seemed to be abnormally small. Operation was suggested, but was refused.

9. Case of Hoffmann, 1870. A man, who died at twenty-eight years of age, had an umbilical fistula at birth which was closed by the use of caustic when the patient was three years old. At the age of twenty-seven years a tumor appeared below the navel, was punctured several times, evacuating urine and bloody pus. Death occurred from acute peritonitis and the necropsy showed cancerous degeneration of the urachus.

10. Case of Joseph Worster, 1877. In 1877 Joseph Worster reported the case of a girl, aged twenty-one years, who had diphtheria at eight years of age, followed by cystitis and the formation of a tumor at the navel from which pus was discharged, and then most of the urine passed by the navel. Later on a second swelling appeared below the navel, which also burst and discharged urine. The urachus was excised, the parts closed with sutures, and recovery followed.

11. Case of J. J. Charles, 1875. A boy, aged one year, with open urachus through which nearly all the urine passed. There was congenital phimosis with a very small opening. After circumcision all the urine passed through the urethra, and the umbilical fistula closed spontaneously.

12. Case of Preston, 1876. In 1876 Preston saw an infant malformed so that its sex could not be determined, with an opening

at the navel through which the urine came. Two years later it was still passing urine through the navel and was robust and masculine in its habits.

13. Case of A. Rose, 1876. A boy, aged eleven years, had passed his urine through the navel since birth. A catheter passed through the navel into the bladder and the fistula was closed by a plastic operation.

14. Case of H. D. Vosburgh, 1877. In 1877 H. D. Vosburgh saw a man, aged about fifty years, who had been complaining of soreness and constant pain at the navel. Examination showed redness, tenderness, and a hard swelling around the navel. The tumor was incised and at the depth of half an inch a stone was felt and removed. The stone was phosphatic, with a strong urinous odor. Recovery followed. The patient stated that about twenty years before a stone had been removed in a similar manner from the urachus.

15. Cases of M. Jacoby, 1877. (*a*) In 1877 M. Jacoby had a patient, aged eighteen years, previously normal, in whom rupture of the navel occurred after twenty-four hours' retention, on account of stricture of the urethra. Nearly all the urine flowed through the navel during the six months that the patient lived, finally dying of consumption.

16. Second case of Jacoby. (*b*) Jacoby reported another case of congenital fistula of the navel cured by two applications of a red-hot iron wire.

17. Case of Cadell, 1878. In 1878 Cadell had a case in an eight-year-old girl, who had suffered difficulty in voiding urine, when suddenly it broke through the navel and continued to discharge by this route until death. The necropsy showed the entire urachus open, and that the cause of obstruction to the urethra was chronic cystitis, with hypertrophy.

18. Case of Ashhurst, 1882. A male child, aged nine months, with an opening in the navel through which urine had escaped since birth. The operation consisted in the application of the actual cautery into the fistulous tract and the ligation of the projection at the navel. Recovery.

19. Case of C. B. Ball, 1883. In 1883 C. B. Ball had a case in a boy, aged eight years, who suffered from incontinence of urine since birth at night, but for six weeks by day also. In March, 1882, the urine was bloody and contained pus, but the boy improved. When he next appeared, in January, 1883, he had a navel fistula which he stated had occurred three weeks previously, when an abscess broke and since that time all the urine had passed through the navel. The treatment consisted in cauterizing the opening, and this was done three times, the parts remaining healed only a short time. A fourth operation of a plastic nature was done, but this kept the opening closed only two months. One month later death occurred from peritonitis. A necropsy showed that rupture of the dilated urachus had taken place, with escape of urine into the peritoneal cavity.

20. Case of C. B. Waller, 1884. In 1884 C. B. Waller had a patient, male, aged five months, who had passed urine through the navel ever since the cord had separated. Caustic had been applied several times without closing the opening. A catheter was passed into the urachus and the urachus exposed by section, the upper part removed and the lower part ligated with silk. The parts were united and recovery followed.

21. Case of A. Vander Veer, 1886. In 1886 A. Vander Veer had a case with Dr. Du Bois, a female, aged twenty years, who, since the tenth day after birth, had discharged urine through the navel at irregular intervals. For the last two years there had been pain, the discharge had become offensive, and the parts about the navel excoriated. The operation consisted in slitting up the urachus, curetting, suturing the lower part, and packing the upper part with iodoform gauze. Recovery.

22. Case of F. Bramann, 1887. In 1887 F. Bramann reported a case in von Bergmann's clinic of a girl, aged twelve years, normal until her ninth year, when she had pain and frequent urination with discharge of pus and a little blood. About two years later the urine suddenly discharged through the navel and had continued to do so since, although her physician had tried by permanent cauterization to cure her. The urachus was dissected out

to the bladder and the opening closed. A fistula followed which, in the short time which had elapsed when the report was made, had not healed.

23. Case of W. J. Penny, 1887. In 1887 W. J. Penny reported the case of a healthy child, aged eleven months, sex not given, who, since separation of the cord on the ninth day, had been passing urine through the navel. A probe passed into the fistula could be felt to touch a catheter which had been passed by the urethra into the bladder. Operation was declined.

24. Case of De Forest Willard, 1888. In 1888 De Forest Willard reported the case of a female child, aged two years, who had passed urine through the navel ever since birth, about half a drachm escaping during the course of the day. The discharge was offensive and excoriation had taken place around the navel. Several vain attempts to close the opening by cauterizing with nitrate of silver had been made. The operation consisted in freshening the edges of the navel, from which union resulted, but in a month broke down and the discharge returned. The parts were then opened, scraped out, cauterized, and a drainage tube put in. Cure resulted.

25. Case of Trendelenburg. Male, aged sixty-six years, with a tumor the size of the head between the navel and pubes. A sound could be passed through the navel, from which urine continually flowed. The tumor was opened and one litre of urine and pus evacuated, and the cyst wall extirpated.

26. Case of W. R. Smith, 1892. A female child on the second night after its birth began to bleed from the navel, and two days later from the urethra. This continued at times for four days, and ceased when the cord came away. He thought the blood came from the hypogastric arteries at the umbilicus, then through the urachus into the bladder.

27. Case of W. Van Hook, 1894. A female child, apparently normal at birth, had abdominal pain, diarrhœa, and vomiting when three weeks old. When five months old was sick again, and the mother noticed a protrusion of the abdominal wall below the navel. Hot applications resulted in an opening at the navel

and the discharge of a large quantity of pus. Later on cystitis developed, and pus continued to be discharged through the navel. Under chloroform a probe was passed down almost to the pubes, but did not enter the bladder. The opening was dilated, a drainage tube put on, and recovery followed in a week.

28. Case of Forgue and Morer, 1895. (Quoted by Guignes.) A soldier, aged twenty years, had from birth passed urine through an umbilical fistula at each micturition, but not at any other time. Most of the urine passed naturally. A sound passed through the navel into the bladder a distance of 16 cm. The patient was perfectly healthy. No treatment.

29. Cases of E. Lexer, 1897. (*a*) A man, aged twenty years, had nothing abnormal about the navel until a year and a half before, when pain and swelling occurred, followed by rupture and discharge of urine and pus. After treating the infection by irrigation, the urachus was excised, the lower opening sewed up, and the parts sutured, leaving a tampon in the lower end. Recovery.

30. Lexer's second case. (*b*) Another of Lexer's cases was a man, aged sixty-seven years, suffering from prostatic hypertrophy. In June, 1897, after prolonged retention, the urine suddenly burst through the navel. The operation consisted in slitting up the urachus, the opening in the bladder being seen, packing with iodoform gauze, and the introduction of a permanent catheter. Death in fourteen days from uræmia.

31. Lexer's third case. (*c*) Lexer's third case was one of great interest, being complicated by the presence of a Meckel's diverticulum. A boy, aged one and one-half years, had discharged urine through his navel ever since the cord dropped off. The urine came slowly and by drops from the urethra, and a high degree of congenital phimosis existed. The prepuce was slit up, with the result that at the end of four weeks very little urine came through the fistula. To close the fistula a pocket around the navel was opened and the mucous membrane at the mouth of the fistula seized with forceps and pulled out, when a kind of sheath, about 5 mm. thick, was drawn out through the navel for a distance of 7 cm., where it was cut off, sewed up, and the stump pushed back

and the skin closed over it. Recovery. Microscopic examination showed the excised sheath to be a Meckel's diverticulum.

32. Case of W. L. Reid, 1897. A woman, aged twenty-five years, about six months previously began to have pain in the umbilical region. Two weeks later a swelling appeared at the navel, which burst and through the opening pus had been discharged, with occasional intervals of a week ever since. A probe was passed through the navel into the bladder and the end emerged at the urinary meatus. Operation: The urachus was opened on a probe, showing a dilatation in the middle, with a constriction above and below, where it connected with the bladder. The actual cautery was used to destroy about one inch of the lower part of the urachus, and the portion above was packed with iodoform gauze. Recovery.

33. Case of A. Kennedy, 1899. A child, aged seven months, sex not given, had been passing urine from the navel since birth. A probe passed into the urachus three inches. A sort of flattened, button-shaped tumor, with a short pedicle and an opening in the centre presented at the navel. Ligation of the pedicle resulted in cure.

34. Case of Levié. A seventy-nine-year-old man, who had suffered many years with difficulty in passing urine on account of prostatic trouble, had the urine suddenly break through his navel and continue to flow by that route. A necropsy showed a pervious urachus.

35. Case of H. J. Garrigues, 1899. At a necropsy on a woman, aged forty-five years, who died after hysterectomy, the bladder was found extending by means of the dilated urachus to the navel, where it was closed.

36. Case of Goldsmith. A boy, aged ten years, had a navel fistula, probably caused by stone in the bladder. The stone was removed by suprapubic section and the fistula at the navel healed.

37. Cases of B. Guisy, 1900. (*a*) A man, aged sixty years, had for five years been passing urine through an umbilical fistula. His previous history showed that he had suffered many years before with gonorrhœa and later severe attacks of renal colic and the

passage of gravels from the urethra. The patient also had urethral stricture. He developed pain and swelling about the navel, and a physician opened the swelling, evacuating urine and pus, since which time the urine has continued to flow by this route, as well as through the urethra. External urethrotomy was performed and two large gravels removed from behind the stricture. Recovery.

38. Guisy's second case, 1902. (*b*) A man, aged thirty-two years, on account of stricture following gonorrhœa, had great difficulty in passing urine, and for two years had suffered pain in the navel. Later a swelling appeared, and one day, during complete retention, this swelling ruptured and urine and bloody mucus were discharged. Since then, for several months, there has been constant leakage through the navel. A small sound passed through the navel into the bladder. The urethral stricture was treated by internal urethrotomy and dilatation, and urine ceased to flow through the navel.

39. Case of L. Imbert, 1901. A girl, aged six years, had passed urine through the navel ever since the cord dropped off on the twelfth day. Operation: The urachus was excised and the lower end ligated with catgut, and the wound closed, leaving the end of the catgut ligature projecting. The patient had scarlet fever and the wound opened superficially, but it was reunited and healed without further trouble.

40. Case of F. Griffith, 1902. A male infant, aged five months, from whose navel there had been a discharge of clear fluid since the detachment of the cord. The fluid was clear, colorless, limpid, and did not have a urinous odor. Treatment: The parts were kept clean, dressed frequently, and adhesive plaster used to approximate the edges. After three months recovery took place.

41. Cases of W. Hird, 1902. (*a*) A male child, who, when five weeks old, began to discharge urine from the navel. Inflammation from extravasation of urine around the navel took place, and the child died.

42. Second case of W. Hird. (*b*) A girl, aged six years, complained of pain about the navel. Later there was a discharge of pus from the navel and a tender lump below. A probe entered

one and one-half inches and pus of a creamy character came out. Suitable dressings resulted in cure.

43. Third case of W. Hird. (*c*) A girl, aged four years, had a chronic discharge from the navel and pain below. A probe was passed in, cut down upon, and the urachus ligated and cut out like a vermiform appendix. No opening into the bladder was found. Recovery.

44. Fourth case of Hird. (*d*) A middle-aged man complained of tenderness and irritable bladder when jolted. A fixed pain set in above the pubes, and there came an increased desire to urinate, with pain on pressure and hardness above the pubes. Suddenly the patient felt something give way, and pus passed from the bladder through the urethra with great relief. Recovery followed, and three years later the patient was well.

45. Case of Matthias, 1902. A man with a neglected gonorrhœa developed symptoms of cystitis and a tumor just below the navel. The cystoscope showed cystitis and a diverticulum from the summit of the bladder, with a small opening in the mucous membrane, through which pus entered the bladder. Operation showed it to be an abscess of the urachus.

46. Case of W. S. Yates, 1902. A male child, aged three weeks, had passed urine through the navel ever since the cord dropped off. The umbilical opening was closed by passing a purse-string suture around the protruding portion, tying and cutting off the protruding part.

47. Case of T. H. Stites, 1903. A negro girl baby, aged nine months, had ever since the separation of the cord discharged urine through the navel. A mass of granulation tissue, with an opening in the centre, was seen in the position of the navel. In five or six weeks cure was effected by cauterizing the orifice several times at intervals.

48. Case of B. C. Stevens, 1904. A boy, aged seventeen years, had all his life passed urine through his navel. Operation: Excision of the urachus and closure of the lower end communicating with the bladder by means of a purse-string suture and inversion, as with the vermiform appendix. Recovery.

49. Swirt's cases. First case, 1904. (*a*) A woman, aged fifty-eight years, complained of retention of urine, while urine dribbled from the navel. A vesicovaginal fistula was established and the urachus closed spontaneously. Later the vesicovaginal fistula also.

50. Swirt's second case. (*b*) A girl, aged seventeen years, had constant dribbling of urine from the navel; also of blood, at menstrual periods. She was cured by splitting the edges of the fistula and applying a purse-string suture.

51. Swirt's third case. (*c*) A boy, aged one and one-half years, had a discharge of urine from the navel, also marked phimosis. Circumcision failed to cure the fistula. The navel was excised and the urachus successfully closed with a purse-string suture. Recovery.

52. Case of H. Tuholske, 1905. A man, aged fifty-two years, who in infancy passed urine through the navel. This condition ceased in his fourth year without treatment and he had no further trouble until forty-eight years of age, when urine again, apparently without cause, began to flow through the navel. The margins of the opening were pared and sewed together, but without effecting a cure. Six months later operation was performed, as follows:

The canal was exposed by incision, and half an inch beyond the margin was found to spread out into the bladder, no division existing between bladder and urachus. The urachus was split down to what should have been the bladder summit and sewed across a distance of two inches. The operation was extraperitoneal. Recovery.

My case is as follows:

Case 53. A. W., white male, aged forty years, superintendent of nurses, was admitted to Georgetown University Hospital June 21, 1904.

*History.* Parents died; father of old age, mother of pneumonia. Two sisters died of consumption; three brothers and two sisters living and in good health. No history of malignant diseases in the family. Patient had the usual diseases of childhood, also diphtheria and typhoid fever. When three years old he suffered with leg ulcers, with foci of necrosis of the tibia. Ulceration

continued at intervals for five or six years, often resulting from traumatism. At the age of six years he was confined to bed for two weeks with severe lumbar pains, fever, and disturbance of digestion. When twenty years old he had gonorrhœa, from which he made a good recovery. His present troubles began when he was seventeen years old with pain in the suprapubic region, extending up to the navel, with induration and tenderness of the part to pressure. These symptoms grew worse, poultices were applied, and two weeks later an opening appeared at the navel, through which was discharged a moderate quantity of pus. From this time the fistula has remained patulous almost constantly, with a discharge of pus and urine. Occasionally it would close, never longer than for two days, during which time there would be considerable pain, especially on urination. When closed the area around and below the navel would become inflamed, and when opened, spontaneously or by the patient, there would be immediate relief from pain and the escape of a large quantity of dark, offensive-smelling fluid. The odor was worse after the fistula had been closed for a day or two than when discharging freely, but at all times it was offensive, to a great extent barring him from the society of his friends. The discharge has always been most profuse during urination and in the morning when he would begin to move about, but there was at all times enough to keep his clothing soiled. At thirty-four years of age he had an attack of pain in the region of the right kidney, with nausea, vomiting, and elevation of temperature, and he had to keep his bed for three weeks. Since then he has had other attacks of less severity, and usually beginning with pain in the loin, extending to the testicle, sometimes accompanied by vomiting and the passage of blood through the urethra. The attacks have always been most severe after exertion. Examination shows a large, robust, well-nourished man, with good color and apparently in excellent health. In place of the navel is a flat area of scar tissue, of a bluish color, containing a small opening into which a probe passes downward and slightly backward for a distance of three and one-half inches into a pouch, which lies in front of the bladder.

Urine from the bladder gives the following result on analysis: Color, amber; reaction, acid; specific gravity, 1018; urea, 10.5 grains to the ounce; urates and epithelial cells.

Urine from the fistula: Pus, chlorides, and 2.4 grains of urea to the ounce.

A diagnosis of complete patent urachus was made, with dilatation into a pouch and infection of its contents, and operation was advised, which was performed June 25, 1904. Under ether the bladder was filled with water through the urethra, and a grooved director was passed through the fistula to the bottom; the cavity was opened and considerable bloody pus, with an offensive, urinous odor, was evacuated.

The sac was pyriform in shape, small end above, and lay in front of the peritoneum and above and in front of the bladder, with which it communicated through a very small opening. The sac was about three inches in length ($7\frac{1}{2}$ cm.), had a capacity of about three ounces (75 c.c.), and contained many laminated blood clots and very much resembled a small urinary bladder, the walls containing muscular and fibrous tissue and being lined with mucous membrane. The sac was carefully dissected out, the peritoneum being opened in two places accidentally, and the muscles and skin were united.

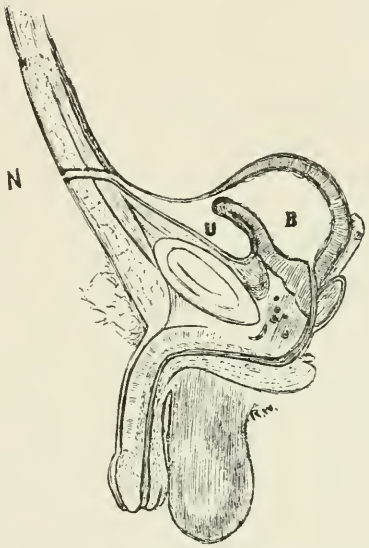
Recovery was without incident, except for the high temperature which occurred on the day after operation, namely, 107° in the axilla, and he was discharged recovered three weeks after the operation.

August 13, 1904, just a month after leaving the hospital, the patient had a severe attack of renal colic on the right side, with chill, vomiting, bloody urine, delirium, swelling of face and extremities, pulse 140, and temperature 104°. August 21st the right kidney was incised and a round stone, half an inch (1.25 cm.) in diameter, was removed.

After this the patient had no further trouble until February, 1905, when he had an attack of renal colic on the left side, with the passage of several small pea-sized gravel from the bladder. A month later he had another attack, only it was much more

severe and was complicated with almost complete suppression of urine for forty-eight hours, delirium, chill, and a temperature of 106°. May 1, 1905, the left kidney was incised and two stones were removed.

Up to the present time, June 27, 1905, the patient has had no further trouble with his urinary apparatus, but has had an attack of appendicitis, which he managed to pass through without operation.




Author's case of patent urachus; *N*, navel; *U*, urachus (dilated); *B*, bladder.

## TUMORS AND CYSTS OF THE URACHUS.

Besides being so often the seat of abscess due to infection, the urachus is sometimes the origin of tumors and of cysts. Wutz found, in his examination of 74 bodies, 24 in which the urachus contained small cysts; that is, cysts varying from microscopic size to that of a bean. All were situated in the lower third or fourth of the urachus, the most of them in old persons; and of the 24 cases 15 were males and 9 females.

Such small growths have rarely if ever given symptoms by which a diagnosis could be made, but the large cysts are more important and give well-recognized symptoms. These cysts are probably of the exudation or retention variety, the material accumulating in a closed cavity formed by the urachus when it is closed at both ends. Such cysts have been reported by a number of observers, among them Tait, who reported 12 "allantoic cysts;" Doran, Carroll and Park, Douglas, Page, and Pratt and Bond.

Cysts of the urachus may be confounded with ovarian cysts or ascites. In urachal cysts the history would be that of a tumor first appearing between the navel and pubes, in or very near the median line, soon followed by symptoms of irritation of the bladder. Later on the cyst may extend into the pelvis and may occupy the greater part of the abdominal cavity, as in the case reported by Douglas. Gallstones may even give symptoms resembling cyst or abscess of the urachus, as was shown by von Bergmann's case, reported by Bramann, in which a woman, aged sixty-three years, presented herself with a tumor between the navel and pubes, and a fistula at the navel discharging pus. Fifteen years before the patient had suffered a long spell of illness, with pain in the right side of the abdomen, after which the tumor above mentioned appeared. Two years later rupture took place through the navel, and the discharge had kept up ever since that time. The tumor was opened over a sound introduced into the fistula, evacuating a considerable quantity of pus and a number of calculi, four of which were as large as pigeon-eggs, and on examination proved to be gallstones. Bramann mentions some cases in which gallstones were discharged through the urethra, possibly, as he suggests, from communication between the ligamentum teres of the liver and the urachus.

In many cases the diagnosis cannot be made before the operation; then the cyst is found lying in front of the peritoneum, usually with a pedicle or attachment at the site of the urachus.

A few cases of malignant tumor, sarcoma, and carcinoma have been reported as originating from the urachus.

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# THE MANAGEMENT OF CERTAIN CRITICAL CASES OF INTESTINAL OBSTRUCTION, WITH REPORT OF CASES.

## (*a*) RESECTION FOR CANCEROUS OBSTRUCTION. (*b*) RESECTION FOR GANGRENOUS INTUSSUSCEPTION. (*c*) RESECTION FOR GANGRENE DUE TO MESENTERIC THROMBOSIS.

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For several years now since the perfection of the technique of intestinal anastomosis, surgeons have been much disappointed at the results of resection in certain critical cases of intestinal obstruction, and especially in cases of obstruction due to cancer of the intestine. It is well known that the mortality of these operations under the prevalent method of enterectomy with immediate suture is 50 per cent., at least in the hands of the best surgeons, and in some hospitals is as high as 85 per cent. In cases of resection for gangrene of the intestine the mortality is even higher. The principal cause of death has been septic peritonitis, due sometimes to contamination by intestinal contents at the operation, but more often to the fact that the most perfectly placed sutures or mechanical devices do not hold. It is hardly necessary to say that the giving way of the suture in these cases is due to the diseased condition of the bowel.

The obstruction caused by cancer is gradual, and a diagnosis is often not made for two or three months, when the obstruction becomes complete. The bowel has then become dilated and hypertrophied; the patient has been weakened by malnutrition and has become cachectic. When such an intestine is opened its walls

are œdematous and often three or four times the normal thickness, and the contents are especially septic. When such tissue is included in a stitch it rapidly shrinks, leaving the stitch loose and leaking. If the stitch holds at first the peristalsis may be violent or sometimes we have complete atony; both conditions may prevent union. In short, the whole situation is most unfavorable for the union of the cut ends; moreover the relief of the obstruction is of more immediate importance than the removal of the disease.

Enterectomy with temporary artificial anus was advocated by Reiche and urged by Treves in 1883. More recently Mikulicz has operated in two sittings for malignant growths of the large intestine.

We have always believed that the mortality in these cases ought to be nearer 10 per cent. than 50 per cent., and having found every form of suture and mechanical appliance unreliable, we have for several years now been doing these operations in two sittings, with most satisfactory results. Now that the technique has been perfected, we think that enterectomy with a temporary artificial anus should be the operation of choice in all critical cases of intestinal obstruction where there is an opportunity for resection, whether it be in the large or the small intestine. Treves and others have objected to leaving a fecal fistula in the small intestine on account of the malnutrition caused by the loss of the undigested discharges from the upper bowel. I have overcome this difficulty in 2 cases (1 here reported, the other in *Annals of Surgery*, January, 1885), in which I resected a part of the small intestine, by collecting the discharge from the upper opening and injecting it into the lower opening. I have also improved the technique of the operation by stitching the open ends of the bowel together on the mesenteric side before they are fastened into the parietal wound. This greatly facilitates the closing of the artificial anus. We have never had a death from closing an artificial anus, though it has occasionally required more than one operation. It is a safe operation and usually hardly disturbs the convalescence.

If the patient is in too critical a condition to risk primary resection an artificial anus may be made in the distended bowel and

the diseased portion resected at a later operation if an opportunity arises. This method is to be condemned except in cases of grave necessity, because at the second operation the peritoneal cavity is opened in the presence of a fecal fistula; also the disease, perhaps malignant, has been allowed a longer time to develop, and it is always difficult to get such patients into good condition for a severe second operation. In using this method in an unfortunate case, at the second operation done one month after opening the bowel, we found the bowel for some distance from the malignant growth degenerated and friable so that the stitches did not hold.

According to Hochenegg's method, the diseased intestine is freed and the mesenteric glands removed. The coil is then brought out of the abdomen and held in position by a fold of iodoform gauze passed through the mesentery. The abdominal wound is closed around the bowel. A few hours later he opens the distended intestine and inserts a glass tube. At the end of twelve days the diseased intestine is removed and the cut ends united and returned into the abdomen. This method is to be commended in that it effectually insures the peritoneum against contamination; but we can see no advantage in leaving the disease for twelve days in the outer wound. It seems equally safe to resect at once. McGraw dissects the tumor free with the glands, then the two limbs of the intestine leading to and from the tumor are joined together by Lembert sutures, and an anastomosis made with an elastic ligature. The abdomen is then closed leaving the anastomosis inside and the tumor protruding outside. The tumor is then cut away and the afferent portion of the intestine is drained until the elastic ligature makes an anastomosis above the resection. This is certainly a most ingenious operation, but it is open to criticism that its safety rests in the ability to prevent leaking about the elastic ligature and sutures placed in diseased intestinal wall, which is the same objection we are raising against resection with immediate suture.

The simplest method seems to us the best. Enucleate the tumor and remove the glands. When the tumor is free draw the loop of

intestine out through the abdominal wound. Wall off the peritoneal cavity with gauze. Clamp the lower efferent bowel and cut it off. Unite the mesenteric sides of the afferent and efferent bowel to facilitate the closing of the artificial anus. Stitch the upper and lower bowel to the peritoneal surface. Close the wound about the ends of the intestines as much as possible; then clamp the upper, distended bowel and cut away the tumor. Pack the wound with gauze. The clamp on the upper, distended bowel can then be removed with certainty that the peritoneal cavity will not be infected by the fecal discharge; or, still better, if the symptoms are not urgent the clamp may be left in place for several hours until the newly adjusted surfaces have been settled into place and have possibly begun to glue together, as in the first case here reported. The important point is not to open the upper, distended bowel until the peritoneal cavity is closed.

In all these cases it is important to wash out the stomach before the operation and leave it empty, as there is great danger of regurgitation in the trachea under ether, due to handling the distended intestine.

Case I.—*Cancerous Obstruction.* Patient was seen June 26, 1904, in consultation with Dr. Baldwin, of Brookline. A very robust man, aged thirty-five years, apparently in perfect health, who had not been able to have a movement of the bowels for six days. He had been constipated for the past six months, but had never seen blood or pus in the stools. There was no pain or vomiting except from cathartics. There was slight tenderness near the umbilicus. No distention; no rise in temperature. During the 26th, 27th, and 28th we tried opium, castor oil, calomel, and enemata without avail, little or no food being given. Only about a quart of water could be forced into the rectum. Operation June 29th. A median incision revealed a hard, puckering, annular growth constricting the sigmoid flexure. The adjacent bowel was freed from its attachments, taking as much mesentery as possible, and raised into the abdominal wound. No affected glands were found. The peritoneal cavity was walled off with gauze, and a ligature placed around the bowel just below the growth. The

bowel was then cut above the ligature and the lower (efferent) gut stitched into the lower part of the wound. The growth, wrapped in gauze to avoid peritoneal contamination, was raised to facilitate further dissection. The mesenteries of the efferent and afferent intestines being stitched together (to facilitate the later closing of the artificial anus) and the abdominal wound completely closed about the intestinal ends, a ligature was then put around the distended afferent gut, the wound surface completely covered with gauze, and the tumor cut away. This ligature was not removed from the distended gut until several hours later, when the gauze dressing had become well glued to the entire wound surface. The patient was much relieved by the operation, and, having no bad symptoms, soon recovered his normal appetite. The gauze in the wound was constantly stained with feces and was gradually cut away as fast as it loosened, leaving a bright, granulating wound. Some of the last pieces of gauze removed from the region near the fecal fistula were seen to be white on the surface next to wound, showing that the fecal discharge had been effectually kept from the deeper part of wound surface by the gauze dressing.

The granulations were bright after the gauze was removed and the wound healed rapidly. In September the open ends of the bowel had become perfectly united to the skin, no granulations remaining.

Dr. Whitney made the following pathological report: The specimen consisted of a piece of intestine about 6 cm. in length, the greater part of which was occupied by a deeply ulcerated, infiltrating new-growth, leaving only a small margin of sound tissue at each end.

Microscopic examination showed a new-growth of irregular tubular glands infiltrating the entire thickness of the muscular coats at the central part and on the ends with a growth into the submucous tissue only. Diagnosis: adenocarcinoma.

Second operation September 30th. The ends of the gut were freed from the scar and united by an end-to-end anastomosis. Recovery was uneventful except for a small infarction which took

place in the right lung on about the eighth day. The patient is now (more than a year after the operation) perfectly well and working as usual.

Case II.—*Gangrenous Intussusception.* The patient, a man aged thirty-eight years, entered the accident room of the Massachusetts General Hospital on May 20, 1904. He had been perfectly well until two weeks before entrance; then he began to have ten or twelve movements of the bowels per day, with constant pain in the left side of abdomen. At times the pain would disappear for a few moments, only to reappear. Vomited considerably during this period and retained but little food; lost weight. Had not vomited blood or passed it per rectum.

The abdomen was moderately distended, and there was considerable muscular spasm. On the left side, running into the flank, an oval tumor was visible about on level of umbilicus, which seemed to move up and down with peristalsis. The tumor was firm but indentable, with an indefinite outline. Rectal examination negative.

*May 21st.* Under free catharsis and enemata the distended abdomen came down considerably. Stools not remarkable. Mass situated between umbilicus and tip of ninth rib on left side. When the large intestine was distended with water the position of the mass was not changed. No gurgling through intestine or under the tumor. Intestinal peristalsis distinctly visible.

*Operation.* Six-inch incision through left rectus about on level with umbilicus revealed the colon much swollen, red, and œdematous, forming a sausage-shaped tumor of elastic consistency eight inches long. The colon was opened by a longitudinal cut and a large gangrenous intussusception removed from the inside of the colon, the mesenteric vessels being tied inside the colon. As the opening into the upper colon where the intussusception had been cut away seemed too small, the cut ends of the gut were pulled apart and stitched into the parietal wound, the longitudinal opening in the descending colon having been closed with a running suture. A glass drainage tube was tied into the proximal opening to carry away the feces. The patient made a slow but

uneventful recovery. The tube sloughed out on the second day and the bowel retracted into the wound.

The artificial anus was almost closed at an operation done three weeks after the first. A very small opening still remaining was closed by Dr. Scudder, who had charge of the wards at that time—a month later. The patient was in good health a year later.

Resection of a gangrenous intussusception with immediate suture is extremely dangerous, the mortality being about 85 per cent. Mikulicz has done a very ingenious operation for this condition. He first stitches the enlarged distended colon into the parietal wound, thus completely excluding the exposed colon from the peritoneal cavity. He then opens the anterior wall of the colon thus excluded and removes the gangrenous intussusception thus exposed by cutting away the outer and inner layers of the intussusception and closing the cut edges by deep catgut sutures, so that the peritoneal cavity is not opened when it is cut away. He then leaves the opening in the colon as an artificial anus, which is closed several weeks later.

Mikulicz has done two cases by this method with good results. So I think we have in Mikulicz's operation perhaps the best operation for the removal of a gangrenous intussusception. But when this operation is unadvisable stitching the open ends of the intestine into the wound is the safest method.

Case III.—*Resection for Gangrene due to Thrombosis of the Mesenteric Vessels.* The patient, a man aged twenty-two years, entered the Massachusetts General Hospital April 7, 1904, with the diagnosis of a duodenal or peptic ulcer. He had had gonorrhœa and syphilis, but no secondary symptoms. He had felt perfectly well until three weeks before entrance, when he began to have pain in epigastrium and vomiting. He had a good appetite, but vomited three or four times a day; the vomitus often had a "coffee-ground" appearance, but he had never vomited fresh blood. He had lost eighteen pounds in weight.

While in the hospital his symptoms and distress increased, and he finally vomited some fresh blood.

*Operation.* On April 14th an anterior gastrojejunostomy was made with a bone bobbin. There was no evidence of disease of the stomach or pylorus. The stomach was not dilated. The small intestine was noted to be thin and friable when stitched and rather dark in color. The patient did well and got early relief from the operation. He had a good appetite, retained and digested his food. On May 2d he complained of a pain in his abdomen, which soon passed away. On May 3d he was seized with more severe abdominal cramp-like pain, with nausea and vomiting. The abdomen was soft and a rounded mass was distinctly felt opposite the umbilicus on the left side. No result from the enemata. May 4th pain more severe, pulse 120, abdomen swollen and tympanitic, so that tumor could scarcely be detected.

*Operation.* Incision in linea semilunaris; small amount of cloudy fluid. A coil of distended and almost black small intestine lay directly beneath incision, with neighboring coils slightly adhering to each other, and a little fibrin on them. The mesentery was black almost to its root. A careful examination showed no constricting band and no sign that the coil had been twisted. The coil was delivered while the peritoneal cavity was "walled off" with gauze, and fourteen inches found to be gangrenous, with a foul odor. About an inch beyond the gangrenous area, or an otherwise healthy part of the gut, was a small dark spot showing another centre of the same process. The affected coil was cut away between two clamps. No fecal discharge was visible. The open ends of the intestine were now sutured to the parietal peritoneum, and the mesenteric borders were stitched together, thus keeping the ends together in order to facilitate a subsequent operation for closing the necessarily resulting artificial anus.

The patient made a prompt recovery. In a few days the skin became irritated by the acrid discharge from the artificial anus, and he began to show the want of proper nutrition. We judged from this that the excised coil must have been high up in the small intestine, a fact not accurately determined at the operation on account of the critical condition of the patient.

The skin around the artificial anus was protected with oint-

ment and nutritious materials were injected into the open bowel; finally we devised a system of collecting the partially digested material discharged from the upper bowel and injecting it into the distal end with a soft catheter. The patient was slightly inclined on one side and the discharge was caught in a glass pus basin. The discharge was periodic and often quite thick. It was injected into the lower gut about five minutes after it came from the upper opening, when the intestine became quiet. It was forced through a soft catheter with a hard-rubber syringe. It had to be given very slowly to be retained, one-half ounce or so at a time with brief intervals until the whole discharge had been returned. In this way his nutrition was greatly improved.

The artificial anus was closed by Dr. Scudder on June 9th, as my term of service had expired at that time. He was discharged July 14th, having gained sixteen pounds, and is perfectly well to-day, more than a year after the operation.

The following is a quotation from the pathological report of Dr. G. H. Wright:

"It is of a black-red color, and at least twice as wide in diameter as normal, the peritoneal surface showing some fibrous thickening. On section the entire wall of the intestine is densely infiltrated with blackish, opaque, thick fluid. The same fluid is found in abundance in the lumen of the intestine. The mucous membrane in general is of a blackish, moist appearance, with no definite ulcerations. The portion of the mesentery adherent to the intestine is markedly infiltrated with black, thick fluid. . . . Microscopic examination of pieces of the mesentery attached to the intestine show thrombosis of good-sized veins, but none of the arteries. . . ." In this case I have not been able to understand why the thrombosis of the mesenteric vessels followed the operation of gastroenterostomy, but I feel certain that the gangrene was due to the thrombosis.

In the *Annals of Surgery*, January, 1895, I reported a case of resection of four feet of gangrenous intestine due to thrombosis of the mesenteric veins. In this case I stitched the open ends of the intestine into the wound as described above. This was the

first successful case recorded of resection for gangrene due to mesenteric thrombosis. Since then, according to Jackson, Porter, and Quimby, who have collected all the cases up to 1904, there have been three other successful cases. They are as follows:

Gordon. Resection of two feet of intestine and end-to-end suture over a bobbin. Intestine leaked into dressing five days after operation. Wound opened and packed, and in two days a slough came away, representing the entire suture line. Resulting fecal fistula closed in two weeks. Recovery.

Kölbing. Intestine resected and lower end of duodenum sewed up (because it was too short for anastomosis) and upper end of jejunum joined to stomach by anterior gastroenterostomy. Much distention and vomiting followed, with right parotitis, fever, and œdema; but patient finally recovered.

Sprengel. Ten cm. of small intestine gangrenous and was excised and ends left in the wound. Peritoneal cavity drained. Good convalescence. Fecal fistula closed five weeks later with end-to-end suture. Recovery.

From this we see that 5 cases have recovered: 1 by Gordon, 1 by Kölbing, 1 by Sprengel, the other 2 done by myself; a mortality of 97 per cent., according to Jackson, Porter, and Quimby. Of these three uninterrupted recoveries were operated on in two sittings, the resected ends being left open at the first operation; while Gordon's case, where end-to-end suture was used, only recovered after the sloughing out of the entire suture line. This leaves Kölbing's case the only one in which immediate suture has acted even fairly well. We think it is, therefore, evident that resection in two sittings has so far proved the most satisfactory method in resections of gangrenous intestine due to thrombosis of the mesenteric artery.

Summary. 1. We find the prevalent method of enterectomy with immediate suture in cases of intestinal obstruction attended with a high mortality due to the changed condition of the distended bowel.

2. Enterostomy with later enterectomy is to be reserved for the cases unable to bear primary enterectomy.

3. Enterectomy with a temporary artificial anus should be the operation of choice in all critical cases of intestinal obstruction, where there is an opportunity for resection, whether it involves the large or the small intestine.

4. The suggested improvements in the technique are as follows: The upper, distended bowel should not be opened until the peritoneal cavity is completely closed. (This is already the practice of several surgeons.)

The open ends of the bowel should be stitched together on their mesenteric side before they are fastened into the parietal wound. This will greatly facilitate the later closing of the artificial anus.

When the artificial anus is in the small intestine the partially digested discharge from the upper opening should be collected and injected into the efferent opening.

5. The closing of the artificial anus is a safe operation and hardly disturbs the convalescence.

6. Up to the present time not enough cases have been done by this method to estimate its relative mortality, but the cases here reported with those referred to suggest a probability of better results than have been obtained by enterectomy with immediate suture.

# ACUTE PERFORATION OF THE GALL-BLADDER WITH FREE ESCAPE OF BILE INTO THE PERITONEAL CAVITY.

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F. O. W., aged twenty-seven years; carriage painter. Has suffered from attacks of colic for the past ten years. These attacks had been diagnosed gastrointestinal colic by the attending physicians. The attacks occurred two or three times a year and lasted from one to ten hours. Accompanying the intense pain there was always bilious vomiting and tympany, but no jaundice. This condition lasted for about three years, when the patient had an attack of jaundice, with severe pain, vomiting, constipation, and usual symptoms of lodgement of stone in the common duct.

After the patient recovered from the jaundice he went to work, the colicky pains still continued, increasing in frequency and severity, and always accompanied by marked gastric symptoms. In the winter of 1900 the patient had another attack of jaundice, with the same set of symptoms. He then went to work again, and for the next four years worked regularly, with only occasional short and not severe attacks of colic.

April 8, 1904 he went to work feeling as well as usual; at 9 o'clock he was seized with a sudden pain in the abdomen, accompanied by nausea, vomiting, and collapse. He was taken home and his family physician called. He was treated by his physician for two days.

He was seen by me in consultation April 11th, about seventy-two hours after the commencement of the attack, and immediately sent to the hospital and operated on.

His condition at the time of operation was critical. The temperature was 102°, pulse 130, respiration 40. The abdomen was very tympanitic. The tenderness was marked, especially over the gall-bladder. The patient had been vomiting continuously for the past twelve hours. His facies was bad. There was only very slight jaundice present, which was probably due to bile absorbed from the cavity. Having had no clinical history of the previous attacks of gallstone colic (the patient being unable to give a connected history of his case at the time of operation), the diagnosis was made of a probable perforating appendicitis, with general or local peritonitis.

The incision was made as if for the removal of the appendix, low down on the right side. On opening the peritoneal cavity a large amount of bile was found in the cavity. There was little or no inflammation of the intestines, although they were everywhere bile stained. The serous coat of the bowels was somewhat congested, though no recent lymph had been thrown out.

The appendix was found perfectly healthy, so it was not removed. The incision was enlarged upward so as to explore the gall-bladder. The gall-bladder was firmly contracted on the stones it contained, none of which had escaped into the peritoneal cavity.

The gall-bladder contained nine large pyramidal stones and a large oval one. This large stone was three inches in circumference, and had a projection on its under surface. This projection, or prong, was two-thirds of an inch long and one-eighth of an inch in diameter, and had by pressure caused an ulceration and perforation in the diseased gall-bladder wall. The opening was large enough to allow of the escape of the bile without allowing the escape of the stones.

The opening in the gall-bladder was about one inch from the fundus on the lower surface, and about one-half inch in diameter.

The gall-bladder wall was hypertrophied and very friable; the edges of the wound were covered with recent lymph.

The opening in the gall-bladder was enlarged and the stones removed.

After the removal of the stones the ducts were explored and

found patulous. A ligature was then passed around the cystic duct and the gall-bladder removed. The peritoneal cavity was thoroughly washed out with several gallons of warm sterile water and dried with gauze sponges, a gauze drain inserted, and the external wound sewed up.

During his convalescence, which lasted four weeks, no untoward symptoms occurred. I have seen him several times since the operation, and he is now perfectly well.

Garrè[1] reports a case very similar to the one reported, except that no gallstones were found:

Woman, aged fifty-three years; had numerous attacks of biliary colic. Last attack three days before admittance to clinic, there was vomiting and constipation and colicky pains. The abdomen tympanitic with great tenderness. Tenderness more marked on the right side. Pulse 100, respirations frequent, slight icterus.

Operated on for appendicitis. Incision low down in region of the appendix. Abdominal cavity contained bile. Appendix normal. The incision was enlarged and the gall-bladder found covered with recent lymph. On breaking up these recent adhesions a fistula was found in the gall-bladder. The gall-bladder was opened, but no stones found. No other conditions were found to explain the perforation. The gall-bladder was drained; the patient was discharged in four weeks perfectly well. Moynihan, in his book, *Gallstones and their Surgical Treatment*, reports a collection of fifteen cases in which surgical treatment was adopted in cases of acute perforation of the gall-bladder; ten of these cases recovered and five died. In some of the cases the gall-bladder was removed, in others the opening in the gall-bladder was enlarged and afterward sewed up, the stones being removed, but in all of the cases the peritoneal cavity was drained after being opened.

The following selected fatal cases reported will show the usual clinical symptoms accompanying the gall-bladder perforation with postmortem findings:

William Pepper[2] reports a case as follows: History of attacks of biliary colic for one year before the acute symptoms took place. These attacks were associated with vomiting, constipation, and

jaundice. Sudden pain in abdomen, accompanied by collapse, vomiting, constipation, and delirium. Death occurred seventy-two hours after the commencement of the attack. Necropsy showed general peritonitis. At a point one inch from intestines was a perforation in the cystic duct. Gall-bladder contained bile and several small stones and biliary gravel.

S. H. Freeman[3] reports a case of a man, aged sixty-five years. History of attacks of colic. Onset sudden, vomiting and intense colicky pains. Death in twenty-four hours.

*Necropsy.* Eleven large stones found in the peritoneal cavity. General peritonitis. Rent in the gall-bladder one and one-half inches in diameter.

Bradley[4] reports a case of a man in good health one month before death. Onset sudden. Symptoms, intense pain, tenderness, fever, collapse, and death. Postmortem showed abscess had formed between gall-bladder and intestinal wall, due to a perforation of the gall-bladder, caused by a stone lodging at junction of cystic and hepatic ducts. General peritonitis present.

Huguenin[5] reports a case of a man, aged fifty-eight years, with rupture of gall-bladder following a papilliform cancer of the gall-bladder.

Hartshorne.[6] Female, aged fifty-two years. Previous history of biliary colic. Onset sudden. Intense pain in abdomen, with vomiting and obstruction of bowels. Death on fourth day.

*Necropsy.* Ulcer in cystic duct had penetrated, allowing bile to escape. Twenty-two stones found in gall-bladder. General peritonitis present.

The clinical history of these cases in brief is almost always about the same. There is always a sudden onset, accompanied by collapse, intense pain, tympany, vomiting, and constipation, associated with more or less fever. A rapid pulse, rapid respiration, and death, in most cases occurring (if not operated) in a few hours or days. There is in almost all cases a history of attacks of biliary colic, with or without jaundice, and accompanied by marked gastric symptoms. The postmortem findings are most frequently a thickened gall-bladder wall, the perforation generally

in the gall-bladder, and almost always a general peritonitis is present.

The causes of perforation of the gall-bladder as given by Garrè are trauma, carcinoma, necrosis from embolus of nutrient vessel, and ulcers from bacterial infection with stone pressure.

Trauma as a cause of rupture has not been considered in this paper. One case has been reported of rupture due to carcinoma of the gall-bladder wall.

Spontaneous rupture most frequently comes from the pressure of gallstones in an inflamed, hypertrophied, and friable gall-bladder wall. Garrè states that about 50 cases of perforation of the gall-bladder from stone pressure are reported. The diagnosis was made in only 6 out of these 50 cases before death. Of these cases in 33 the perforation occurred in the gall-bladder, in 1 in the hepatic duct, in 5 in the common duct, and in 4 in the cystic duct. In the remaining cases the point of rupture was not mentioned.

The question of the sterility of the bile in a gall-bladder containing stones is an important one to be considered.

Fraenkel and Braun examined the bile in eleven cases of gallstones and found it sterile in five; Mikulicz examined the bile in twenty-three cases and found it sterile in five cases.

Mayo says a gall-bladder containing stones once infected is always infected to a greater or less degree. Most authorities agree that gallstones are always preceded by cholecystitis. If we cannot have gallstones without an infection of the gall-bladder, leaving out the cause of infection, either from the intestine or through the blood, then the mere fact that stones exist means an infected bile, the virulency of the infection varying in different cases. In the case reported the bile was not examined for bacteria, but judging from the slight inflammatory conditions found, the conclusion must be drawn that, if not sterile, the sepsis was so attenuated as to produce only a slight exudate on the gall-bladder about the rupture, remembering that the bile had been in the peritoneal cavity for seventy-two hours. In these cases an important consideration is as to the kind of operation to be performed. Shall

the gall-bladder be excised, or shall the stones be removed and the gall-bladder drained? Realizing the probable condition of the wall of the gall-bladder, hypertrophy with friable wall, cholecystectomy with drain of the peritoneal cavity after the removal of the gall-bladder is probably the best operation.

In the case reported the gall-bladder wall was hypertrophied and softened, so that it was thought best to remove it.

In most of the cases reported nothing is said about the condition of the wall, but in all probability hypertrophy with inflammatory exudate in the tissues renders the wall softer.

Experiments in animals prove that sterile bile does not cause peritonitis. If a large quantity of sterile bile is injected the animal dies in from six to eight days from cholæmia. Infected bile will cause adhesive peritonitis when the septic bile is diluted. Extremely septic bile will cause acute general peritonitis and death in a short time. The milder form of peritonitis is sometimes cured by tapping and drainage. Experiments prove that cases of escaping bile from the gall-bladder must be operated to prevent death from peritonitis or cholæmia.

In man, in cases of escaping bile into the peritoneal cavity, most of the patients die, depending upon the infective property of the bile from cholæmia or acute and chronic peritonitis unless relieved by operative procedure.

All authorities agree that the bacteria most frequently found in gall-bladders containing stones are bacillus coli communis, staphylococcus, streptococcus, and typhoid bacillus.

The frequency of the occurrence of gallstones is surprising. Riedel claims that in Germany in 10 per cent. of all postmortem examinations gallstones are found. Mosher, in Johns Hopkins reports, shows that gallstones occur in almost 7 per cent. of all persons, and prove fatal in 10 per cent. of all cases occurring. Naunyn writes, "On an average every tenth human being, and of elderly women perhaps every fourth, have gallstones."

With this condition existing so frequently it seems that perforation of the gall-bladder should always be considered in cases of acute peritonitis of unknown origin.

Statistics of the percentage of cases of perforation following gallstones are difficult to obtain. The percentage is certainly very small.

One of the reasons for the infrequency of cases of perforation of the gall-bladder, with the free escape of bile into the peritoneal cavity, is probably due to the fact that quite frequently before the ulceration is complete an adhesion is formed between the gall-bladder or duct with a neighboring viscus, forming later a fistula. This fistula may be formed between the gall-bladder and the stomach, duodenum, ileum, colon, urinary passages, thorax, abdominal wall, retroperitoneal tissues, and portal vein.

Naunyn tabulates 43 cases out of 10,866 autopsies; in 19 cases the fistula connected the gall-bladder with the duodenum, in 16 with the colon, in 5 the common duct and duodenum were connected, and in 1 each the fistula was between the gall-bladder and stomach, in the liver, and between the several bile-ducts.

The following conclusions can be drawn from a consideration of this class of cases:

1. In cases of peritonitis with a previous history of gallstone colic rupture of the gall-bladder must be considered.

2. Sterile bile in the peritoneal cavity does not cause peritonitis, but may cause death from cholæmia.

3. In the majority of cases of perforation of the gall-bladder the bile is infected, the virulency of the infection varying in different cases.

4. The perforation occurs more frequently in the gall-bladder than the ducts.

5. Cholecystectomy is the operation of choice, on account of the thickened condition of the gall-bladder wall.

6. In all cases where bile is free in the peritoneal cavity the cavity must be washed out thoroughly and drained at time of operation.

7. The prognosis depends upon the virulency of infection of the bile and the time elapsing between the perforation and operation.

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4. Wm. Bradley. British Medical Journal, 1870, vol. ii. p. 439.
5. Hueguenin. Virchow's Archiv, vol. clxxiii. p. 552; Medical News, 1903, vol. lxxxiii. p. 940.
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# CONSTRICTION OF THE DUODENUM BELOW THE ENTRANCE OF THE COMMON DUCT AND ITS RELATION TO DISEASE.

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Several years ago my attention was first directed to an interesting condition which is frequently present in patients who come under my observation during gall-bladder and stomach operations.

In many of these cases the duodenum is distended with gas to a point just below the entrance of the common duct, while below this it is contracted, and upon raising the transverse colon and finding the origin of the jejunum, this portion of the intestine will also be found in a contracted condition.

In looking over authorities upon the subject of anatomy, I found that they all state that the third portion of the duodenum is the narrowest part of this intestine if they make any statement upon the subject. They also state that the first portion of the duodenum is usually found stained with bile after death.

Several further clinical observations pointed in the same direction.

It was found that the dilatation of the upper portion of the duodenum was most commonly present in patients suffering from chronic cholecystitis with sand or gallstones in the gall-bladder. In these cases there was frequently a more or less marked enlargement of the pancreas.

In having the vomitus examined systematically for a consider-

able period of time in patients who had been subjected to general anæsthesia for operation, it was found that the vomitus invariably contained bile, showing that there must be some reason why this fluid should be forced upward past the pyloric sphincter rather than downward through the small intestine.

Again, it was found that in patients suffering from acute gall-stone colic, the spasmodic pain would subside invariably within a few hours upon making careful gastric lavage and prohibiting the introduction of any kind of food into the stomach, although without this aid large doses of morphine, given hypodermically, had given at best only temporary relief in these cases.

This seemed to indicate that there must be some point near the entrance of the common duct into the duodenum which regulates the passage of food through this intestine.

Since making these observations the beautiful experiments of Dr. Cannon, and more recently those of Cannon and Blake,[1] have added another fact in the same direction by demonstrating that there is a distinct mixing process which takes place in the upper portion of the duodenum.

These clinical observations have induced me to make a careful anatomical study of this portion of the small intestine, both in the living patient and in the cadaver.

My assistant, Mr. E. W. Thuerer, has dissected ten specimens and has made accurate full-size tracings of the duodenum in each of these cases. He has further confirmed our observation by inspecting the duodenum in all cadavers dissected in the Medical Department of the University of Illinois during the past winter.

These specimens show a marked uniformity in several directions, as will be seen at once from the drawings.

In all of these specimens there is a greater or less degree of narrowing between the pylorus and the entrance of the common duct; this can also be seen perfectly in the specimens at the present time, although their immersion in preserving fluid has, of course, brought about some changes.

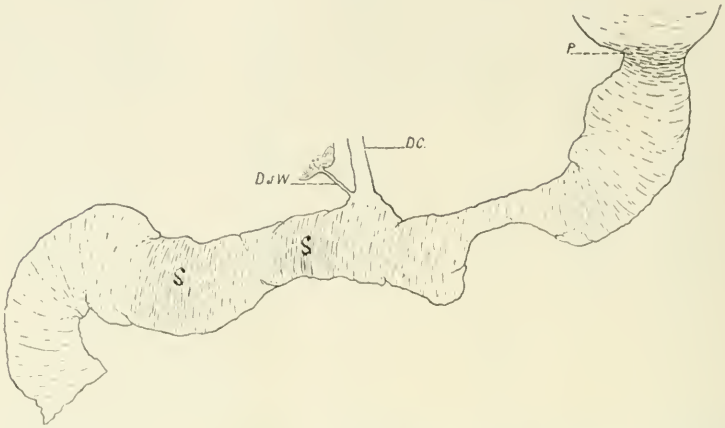
[1] Annals of Surgery, May, 1905.

| No. | Hosp. No. | Sex and age. | Occupation and nativity | Past history and family. | Condition. | Character. | Complications. | Examination. | Condition at operation. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 15342 | F. 39 | Housekeeping, U. S. | Unimportant. ? | Gastroenterostomy, cholecystostomy, gastric ulcer, cholecystitis. | Epigastric pain, vomiting; hæmatemesis six years. | Appendicitis 2 years ago, appendectomy 2 years ago; relief for 1 year and then recurrence of symptoms. | Epigastric tenderness; gastric ulcer; stomach not dilated. | Posterior surface near pylorus, gaping pylorus, duodenum distended; gall-bladder enlarged, sacculated, and contained dark, sandy bile; no stones. |
| 2 | 15346 | F. 40 | Housewife, U. S. | Unimportant. ? | Gastric ulcer, chr. appendicitis, gastroenterost'my, appendectomy. | Epigastric pain and gastric distress; seldom vomiting blood. | None. | Epigastric tenderness; stomach dilated; emaciated and anæmic. | Scar of old ulcer on anterior surface of pylorus; lymph glands enlarged, pylorus open 6½ cm.; appendix walls thickened; gall-bladder and pancreas normal. |
| 3 | 15598 | M. 49 | Farmer, Sweden. | Liver trouble, cholecystitis. ? | Gastric ulcer, cholecystitis, gastroenterost'my, cholecystostomy. | Right hypochondriac pain and constipation ten years; vomiting first three months; no blood; colicky pain in inguinal region. | Neurosis. | Tenderness beneath right costal margin and in right inguinal region. | Scar on posterior surface of pylorus, which is contracted and on jejunum; gall-bladder sacculated, distended with dark, sandy bile; appendix normal. |
| 4 | 15635 | F. 34 | Housewife, Sweden. | Neurotic. ? | Ulcer duodenum, gastrectasis, lacerated perin'm, gastroenterost'my. | Vomiting and headaches. | Neurosis with enteroptosis. | Thin, anæmic; no marked abdominal tenderness. | Stomach and duodenum dilated; lymphatics enlarged; appendix and gall-bladder normal. |
| 5 | 14254 | F. 29 | ..... U. S. | Unimportant. ? | Cholecystitis, panereatitis, gastrectasis, appendicitis, cholecystostomy, appendectomy. | Gastric distress after eating; intermittent attacks of vomiting; no hæmatemesis. | None. | Epigastric tenderness; emaciation and anæmic; anorexia. | Duodenum as large as stomach as far as common duct, where it is adherent to enlarged pancreas and constricted; appendix cicatricial; duodenum adherent to liver. |
| 6 | 14427 | F. 24 | ..... Denmark | Unimportant. ? | Gallstones, chr. appendicitis, cholecystostomy, appendectomy. | Epigastric, right hypochondriac and right inguinal pains; nausea, vomiting, jaundice; no hæmatemesis. | None. | Tenderness beneath right costal arch; poorly nourished and anæmic. | Duodenum enlarged, ducts free; cystic duct dilated; gall-bladder contains stones, black sandy bile, and shreds of tissue. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 14580 | F. 48 | Housewife, Sweden. | Typhoid at 21 years. ? | Cholecystitis, gastrectasis, appendicitis, cholecystostomy, appendectomy. | Appendicitis attack six years; for two years epigastric pains, radiating to right side and back; vomiting. | None. | Tenderness over McBurney's point beneath the right costal margin and over the middle epigastrium; fairly well nourished, but anæmic. | Stomach and duodenum down to point opposite papilla dilated; omentum adherent to thickened gall-bladder, which contained dark bile. |
| 8 | 14603 | F. 53 | Housewife, U. S. | Recurrent attack of gastritis. One sister died, ulcerated stomach. | Gallstones, gastrectasis, pancreatitis, appendectomy, cholecystostomy. | Epigastric pain after eating lasts an hour; never vomits. | None. | Tenderness marked over Robson point; poorly nourished and anæmic. | Stomach and duodenum down to point opposite papilla dilated; pancreas enlarged; common and cystic ducts contain stones; chronic appendicitis. |
| 9 | 14638 | F. 51 | Housewife, Sweden. | Typhoid at 18 years. 2 brothers died of gastric tro'ble; cancer. | Cholecystitis, pancreatitis, cholecystostomy. | Hypochondriac pain; seldom vomiting; tenderness. | Epilepsy. | Tenderness in both upper abdominal quadrants. | Duodenum dilated down to papilla; pancreas enlarged and hard; gall-bladder enlarged, walls thickened, contains tarry bile. |
| 10 | 14666 | F. 31 | Housewife, U. S. | Recurrent attack of stomach trouble. | Cholecystitis, appendicitis, cholecystostomy. | Recurring attacks of epigastric pain, gastric distress, vomiting and jaundice. | None. | Well nourished; tenderness beneath the right costal margin. | Duodenum dilated; gall-bladder contained tarry bile; appendix distended. |
| 11 | 14728 | F. 68 | Housewife, German. | Unimportant. ? | Cholecystitis, pancreatitis, appendicitis, cholecystostomy. | Hypochondriac pain; vomiting. | None. | Emaciated, anæmic; epigastric tenderness. | Duodenum greatly distended; gall-bladder contained black sandy bile. |
| 12 | 14787 | F. 58 | Housewife, Sweden. | Chlorosis at 16 years. ? | Cholecystitis, pancreatitis, cholecystostomy. | Constipation about two years. | None. | Emaciated, anæmic. | Duodenum dilated, pancreas enlarged; gall-bladder contained tarry bile. |
| 13 | 15443 | M. 39 | Machinist, German. | Typhoid in boyhood. ? | Gallstones, cholecystostomy, pancreatitis, appendectomy. | Recurrent attacks of epigastric pain with vomiting; jaundice at times. | None. | Tenderness above McBurney's point and just above the umbilicus. | Duodenum dilated, pancreas enlarged; cholelithiasis, cholecystitis, chronic appendicitis. |
| 14 | 15689 | F. 48 | Housewife, Sweden. | Unimportant. ? | Gallstones, pancreatitis, cholecystostomy. | Recurrent attacks of epigastric pain and vomiting; no jaundice. | None. | Epigastric and hypochondriac tenderness; well nourished. | Stomach and duodenum dilated; pylorus normal; gallstones, cholecystitis, pancreatitis, dark sandy bile. |

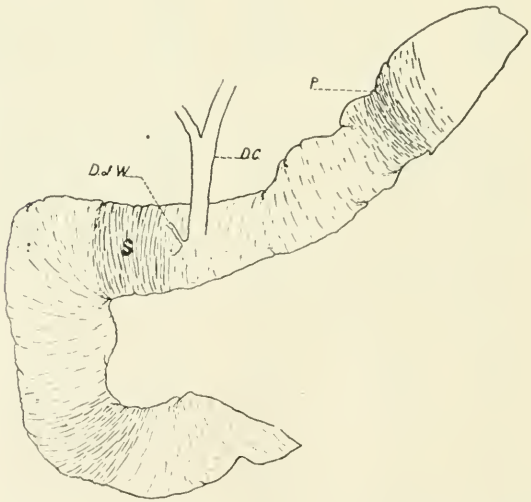
In all of these specimens there is also a more or less marked thickening of the intestinal wall at a point 2 to 4 cm. below the entrance of the common duct, and a careful study of this thicken-

FIG. 1




*P*, Pylorus; *D.C.*, common duct; *D. of W.*, duct of Wirsung; *S*, a double sphincter.

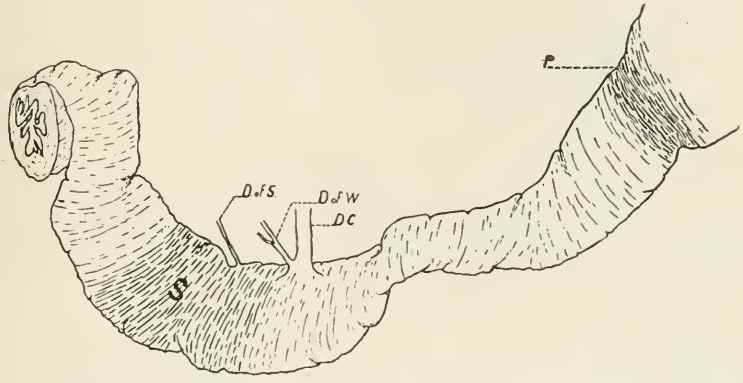
FIG. 2




*P*, Pylorus; *D.C.*, common duct; *D. of W.*, duct of Wirsung; *S*, sphincter below common duct.

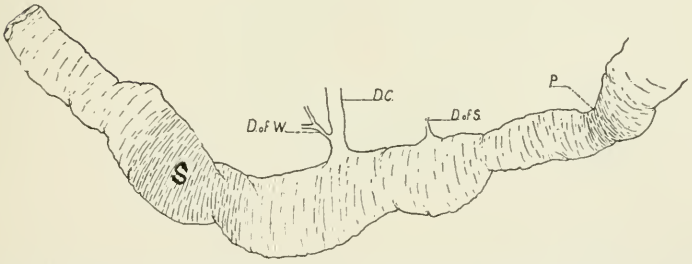
ing demonstrates the presence of a marked increase in the circular muscle fibres, as is shown by the accompanying microscopic sections taken from various portions of the intestinal wall as compared with this portion of the wall.

FIG. 3




*P*, Pylorus; *D.C.*, common duct; *D. of W.*, duct of Wirsung; *D. of S.*, duct of Santorini; *S*, sphincter below entrance of common duct.

FIG. 4

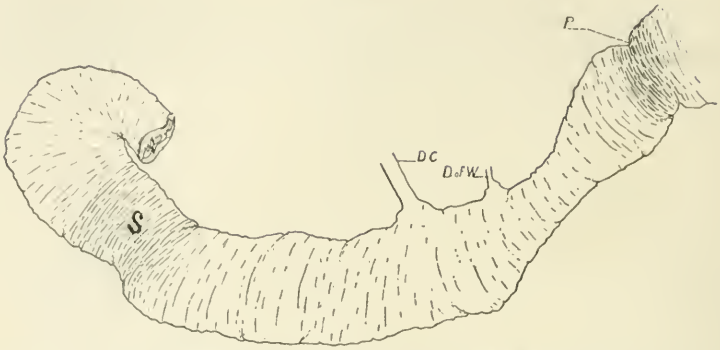



*P*, Pylorus; *D.C.*, common duct; *D. of W.*, duct of Wirsung; *D. of S.*, duct of Santorini; *S*. sphincter below entrance of common duct.

The arrangement of these circular muscle fibres would remind one very forcibly of the arrangement in the pylorus, although the fibres are much more diffuse, making a broad sphincter.

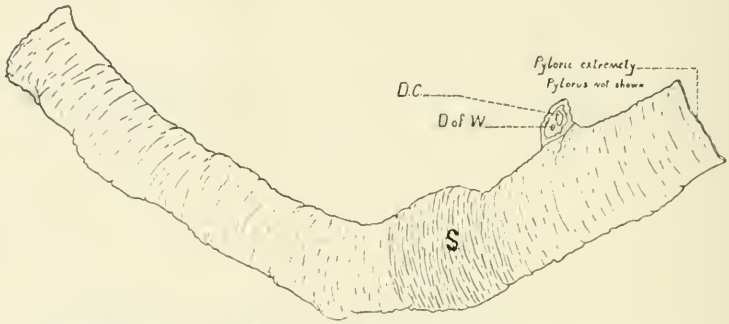
It seems as though all of these facts pointed toward the presence of a sphincter at this point whose physiological function would

FIG. 5



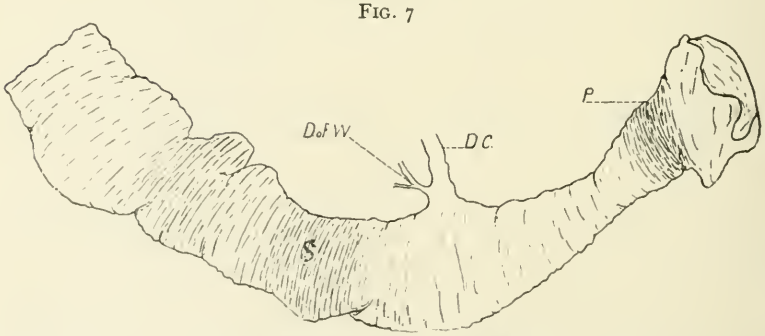

*P*, Pylorus; *D.C.*, common duct; *D. of W.*, duct of Wirsung, 2½ cm. from *C.D.* toward *P.*; *S*, point of greatest development of circular muscle fibres 10 cm. below the entrance of the common duct.

FIG. 6




*D.C.*, common duct; *D. of W.*, duct of Wirsung; *S*, sphincter below entrance of common duct.

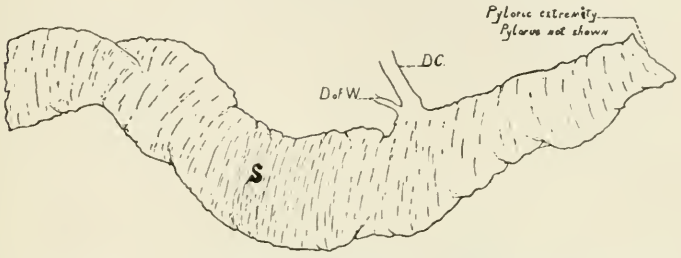
FIG. 7




*P*, Pylorus; *D.C.*, common duct; *D. of W.*, duct of Wirsung; *S*, point of greatest development of circular muscle fibre.

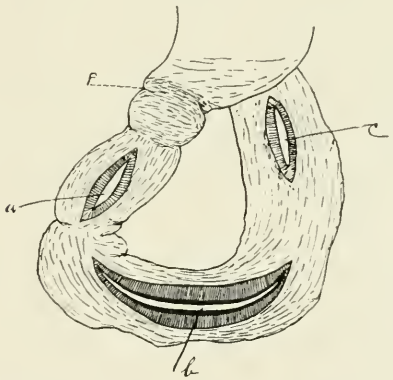
consist in providing for a means of retaining the chyme in the upper portion of the duodenum sufficiently long to provide for a thorough mixing with bile and pancreatic fluid, just as the pylorus

FIG. 8




*D.C.*, common duct; *D. of W.*, duct of Wirsung; *S*, point of greatest development of circular muscle fibres.

FIG. 9



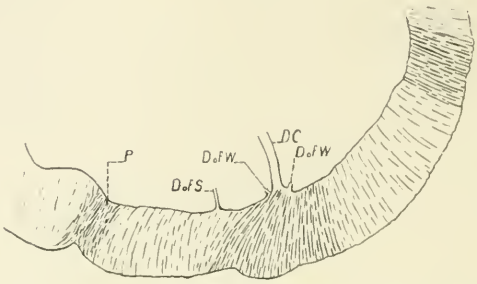

*P*, Pylorus. The longitudinal incisions *a*, *b*, and *c* show the relative thickness of the circular muscle fibres (1) between the pylorus and the point of entrance of the common duct, (2) at the point of greatest thickness 4 cm. below the common duct, and (3) at the point of the duodenum 15 cm. below this point.

serves the purpose of retaining the stomach contents, and the ileo-cæcal valve of retaining the contents of the small intestines.

We have long known that under certain pathological conditions the obstruction offered by the pylorus is increased far beyond the normal.

We also know that the passage of intestinal contents and gas is obstructed to a marked extent at the ileocæcal valve in case of inflammation in this vicinity, which is, of course, usually due to appendicitis, and it has seemed to me as though the above facts

FIG. 10




*P*, Pylorus; *D. of S.*, duct of Santorini; *D. of W.*, duct of Wirsung, double in this case. The circular muscle fibres arranged obliquely, there being a sphincter-like arrangement directly opposite the entrance of the common duct.

would indicate that under certain forms of irritation or inflammation of the gall-bladder or ducts this duodenal sphincter had taken up a similar action, which would have to be considered physiological in character.

# FURTHER EXPERIENCES IN THE RADICAL OPERATION FOR THE CURE OF ANEURYSM BY THE AUTHOR'S METHOD OF INTRASACCULAR SUTURE (ENDOANEURYSMORRHAPHY);

## INCLUDING THE REPORTS OF TWENTY-ONE CASES OPERATED UPON BY THIS METHOD.[1]

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Since the reading of my first paper on this subject at the Albany meeting of the Association in June, 1902, and its publication in the Transactions for the same year (vol. xx. pp. 396–434), also in the *Annals of Surgery*, February, 1903, seventeen aneurysms operated upon by fourteen different surgeons have been added to the list of the four personal observations presented in my original report. Combining my first 4 cases, reported in 1902, with the 17 which have come to my notice since that time, I am able to present a total of 21 cases of aneurysm treated by this method or by minor modifications suggested by it (all in the United States) up to the present time.

Several of these cases have already appeared in various journals, but the majority will be given publicity for the first time in this report. I am gratefully indebted to the operators who have kindly interested themselves in this operation and have so courteously acquainted me with their observations in personal communications. It is very probable that other cases of aneurysm treated by this method or some of its modifications have not been included in this

[1] Since this paper has been written the list has increased to twenty-seven cases, as will be seen in the supplement.

report, but I have failed to find reference to them in spite of diligent search in the current literature and in the discussions of societies in which they would be likely to appear. I would, therefore, avail myself of this favorable opportunity to ask the Fellows and other surgeons outside of the Society who may have tried this procedure, whether successfully or not, to favor me with their observations so that I may be able to gather sufficient data to permit me to make a further comparative study of this method and of the special indications and variations in its technique.

In spite, however, of the comparatively small number of cases collected, the analysis of the individual reports as they are now presented from the original sources, in this paper, is decidedly encouraging and, I am happy to add, fully confirms the expectations based upon my earlier personal experience. It is also very gratifying and encouraging to know that all the surgeons who have contributed to this report, whether in their published writings or in their personal letters, have expressed themselves thoroughly satisfied with the efficiency of the method and the simplicity of its technique. There are, however, several questions still pending which must be decided by a larger experience and a more extended period of observation. These chiefly refer to the indications for arterioplasty in fusiform aneurysm, where the continuity of the main artery is interrupted by its expansion or fusion into the sac; the ultimate value of this procedure from the functional point of view; the best method of obliterating the sac,—a phase of this operation which has already been made the subject of variations from the typical technique by some of the authors who have contributed to this report; and, lastly, the question of drainage.

Before taking up these questions in detail, I deem it necessary to revert to my first paper in order to define more clearly, if possible, the essential features of this operation and the scope of its technique, so that its indication may be the better understood.

I fear that in spite of my efforts to elucidate the essential steps of this operation and to simplify the modus operandi, a great deal of confusion and misapprehension still exists in the minds of many practitioners and surgeons who, having obtained their information

from abstracts and second-hand descriptions given in journals and even text-books, regard it as a difficult and complicated procedure, necessarily restricted to a small group of cases. As an example, I would refer to a little manual or handbook of surgery, recently issued, in which the author, after describing in detail all the old and classical methods of treating aneurysm, disposes of the procedure which I advocate, and which Bullock first associated with my name, by merely stating: "The formation of a new artery from the sac by suturing, after laying open the aneurysm and turning out the clot, is proposed by Matas in selected cases (popliteal aneurysm)." I have selected this instance as an example of the descriptions which are not infrequently met in current literature, to which I object most emphatically because of the grave injustice done to the procedure by restricting its value and application to an extremely limited sphere of usefulness. Such misconceptions of this procedure demand rectification in order that the operation may not be divested of its chief merit as a simple and thoroughly practical measure applicable to the vast majority of cases in which the ligature and methods of incision and extirpation are still currently applied as the preferred methods. The errors that I wish to correct are: the belief that this intrasaccular suture is a difficult procedure, technically; and that arterioplasty, or the reconstruction of the artery, not of the sac walls, is the essential and necessary feature of the operation—whereas, in reality, it is only a secondary variation or development of the fundamental procedure and is applicable only to a limited number of cases of fusiform aneurysm. The bolder, more novel, and aggressive *arterioplasty* has clung tenaciously to the mind of superficial reviewers because of its greater novelty, and the less pretentious, but more generally applicable and effective, *arteriorrhaphy* as applied to sacciform aneurysms and the average fusiforms, is overlooked and ignored. By extending the application of the suture in this way, the vast majority of accessible surgical, and especially peripheral, aneurysms become amenable to this mode of treatment.

In order to understand the technique plainly and for the benefit of those who have not had access to my original paper, let us bear

in mind that we meet in practice with two distinct types of aneurysmal sacs:

1. *The Fusiform Type.* By far the most common (in our experience 66.6 per cent.) are fusiform sacs, in which the aneurysmal sac is formed at the expense of the artery—*i. e.*, the sac is an expansion of the artery. The parent artery is dilated throughout its circumference and merges or fuses into it so that its coats are blended with those of the aneurysm; as a result, the continuity of the parent artery is interrupted for a variable length and is lost in the sac, to be restored once more, as a normal vessel, at the outlet of the aneurysm. Such aneurysms may be compared in their more typical form to the expanded bulb of a rubber (*e. g.*, Davidson) syringe, to which are attached at each pole the inlet and outlet tubes. When aneurysms of this kind are laid open they will present two orifices separated by variable intervals in the aneurysmal wall, the openings varying from a few lines to several inches.

The increasing frequency with which the radical operation is being performed is opening a new field of study in aneurysmal interiors and, from the facts I have gathered, great variations in the relative position of the arterial orifices in the sac exist. These differences are chiefly the result of the adaptation of the sac to the variable resistance of the surrounding parts, the sac expanding in the direction of least resistance and moulding itself to its environment. The position of the orifices is also influenced, primarily, by the seat of the lesion, in the vessel, which originally led to the formation of the aneurysm.

In the majority of fusiform aneurysms, as far as our present experience permits us to state, the inlet and outlet of the aneurysm are found at the bottom of the sac, often corresponding to the upper and lower poles of the tumor, when this assumes an ovoidal shape. Eccentric and anomalous implantations of the artery into the sac are of frequent occurrence and are to be expected, certainly, in no less than 12 per cent. of the cases, but a careful search in the interior of the sac will always reveal the openings in some part of the parietes, either in the sides, at opposite points, or on the

surface nearest the operator. This last possibility must be borne in mind when cutting into the sac, for fear that either the afferent or efferent trunk may be cut into while opening the sac, one of the vessels, more often the afferent trunk, lying flattened and spread upon the convex surface or dome of the sac, right in the way of the operator. If this is remembered, the operator will usually avoid such an accident by carefully examining the exposed surface of the sac before dividing it.

In the type of fusiform sacs most frequently met in practice, the two larger openings of the parent vessel are plainly seen, usually of a larger calibre than the normal arteries, lying at opposite points, nearly on the same level, in the *floor* of the sac, and separated by an interspace which may vary from one inch or less to several inches. It is evident that in such cases, especially when the interspace or gap between the interrupted ends of the vessel is short, and when the walls of the sac are thick, firm, resistant, and pliable, it is technically possible, and even easy, to restore the lost continuity of the parent artery by rebuilding a new channel out of the sac wall. This is particularly true of those cases in which a distinct and often deep groove exists between the two orifices of the sac, indicating the position of the original vessel. I have already described in detail the technique by which this can be done by suturing the walls of the sac together over a guide (rubber tube or catheter) leading from one orifice to another. This method has been applied very efficiently and apparently without any serious difficulty by Drs. Robert T. Morris, Craig Barrow, and very recently by Dr. J. A. Danna, the first two having already contributed two very valuable papers to the published literature of this operation.

2. *The Sacciform or Sacculated Type.* In this morphological variety the parent artery is involved in only a part of its circumference, the aneurysmal sac is developed at the expense of only a part of its walls, and the continuity of the vessel is not lost. Its calibre is retained almost as a normal vessel and the sac is simply grafted or attached to the artery by a narrow neck, forming a sort of diverticulum of variable shape and dimensions. When a sac

of this type is opened, a single orifice or fenestrum will be seen in some part of its wall, which will permit a guide or probe to enter readily into the main artery. This single opening is of variable size, sometimes very small, sometimes large enough to allow the index to engage in it, depending usually upon the calibre of the parent vessel; the opening is usually oval in shape, with its long axis parallel to the axis of the main artery. Sometimes it is placed transversely to the long axis of the artery, involving a considerable part of its circumference. But this is exceptional, if we may judge from present experience, as in all our cases (7 out of 21, or 33.3 per cent.) the long axis of the orifice was parallel with the long axis of the artery.

In this class of aneurysms it is evident that if the opening or fenestrum which connects the cavity of the sac with the interior of the artery is closed by suture the sac will be obliterated—that is, the aneurysm will be cured without interfering with the arterial current flowing in the artery connected with it.

After the preliminary study of the sac-forms, in which I have been materially assisted by a comparison of the observations which have accumulated in the last two and a half years, we are prepared to consider the operation itself as viewed in the light of our present collective experience. The first result of this experience has been the need of defining, even more sharply than I did in the paper of 1902, the distinction that exists between arteriorrhaphy and arterioplasty as applied to the methods of suture in the surgical treatment of aneurysm. In order to avoid misinterpretations, and at the risk of prolixity and reiteration, I would submit the following classification of the various procedures, which in my first paper I grouped collectively under the designation of:

### Endoaneurysmorrhaphy.

### The Method of Suture as Applied to Aneurysmal Orifices and Sacs.

*Def.* A radical operation without extirpation of the sac, applicable to all aneurysms (whether traumatic or pathological), with formed sacs, in which the circulation can be controlled

It essentially consists in opening the sac freely without disturbing it from its surroundings, and in closing all visible vascular orifices by suture applied from the interior of the sac, thus securing complete hæmostasis and permanently stopping all further access of blood to the aneurysmal cavity. The sac is then obliterated by approximating its walls by one or more superimposed tiers of buried absorbable sutures, which bring the endothelial surfaces in apposition (intima to intima), contracting and obliterating the cavity in its greater part. Finally, the portions of the sac still adherent to the skin flaps are turned or inverted into the cavity (or what is left of it), where they are held in place, edge to edge, without leaving dead spaces. This treatment of the sac is carried out in all aneurysms leaving a large cavity, but is susceptible of several modifications in accordance with topographical and other special conditions described and fully provided for in the author's paper of 1903.

This typical or fundamental procedure (obliterative endoaneurysmorrhaphy) *without arterioplasty*, as above described, is applicable to all fusiform aneurysms with brittle, friable, and pathological walls in which there are two or more orifices of supply, and in which the parent artery is entirely lost in the aneurysmal sac. *In these cases (and they are the majority) no attempt is made to reconstruct the parent artery (arterioplasty), and the arterial orifices are simply obliterated by suture*, thus shutting off the sac from all communication with the general circulation, and yet without disturbing its nutrition or interfering with the collateral circulation in the immediate vicinity of the sac. Fifteen of the 21 cases have been operated by this method (71.5 per cent.) and all have been successful; no deaths, no secondary hemorrhage, no gangrene, no relapse, and no functional disturbances having been recorded in any of them.

*Variation No.* 1. Endoaneurysmorrhaphy *with partial arterioplasty* for sacculated aneurysms, in which the sac connects with the main artery by a *single* orifice of communication. By opening the sac freely and washing off the clots the opening in the sac is readily closed by a continued suture, which penetrates through all

the coats of the sac at the margin of the foramen of communication. By this procedure the blood supply of the sac is permanently arrested and the lumen of the parent artery remains patulous, leaving the arterial supply of the limb, or dependent territory (brain, etc.), uninterrupted and in a perfectly normal condition.

The sac is then obliterated by approximating its walls by rows of sutures and in the manner previously described.

(Four of the twenty-one cases reported have been treated in this manner and all have recovered without accident or relapse. I would look upon this as an *obligate* procedure in all operable *sacculated* aneurysms).

*Variation No.* 2. Endoaneurysmorrhaphy *with complete arterioplasty*, applicable solely to fusiform aneurysms in which the sac walls are firm and resistant and the two openings leading to the main artery are in close proximity and are visible in the bottom of the sac. In aneurysms of this type, especially those of traumatic origin, the continuity of the parent artery may be restored by making a new channel out of the walls of the sac by simply folding these over a rubber guide (tube or catheter) and suturing them firmly together so as to restore the continuity of the artery lost in the sac. This last variation is technically feasible as shown by the cases reported by Morris, Barrow, and, very lately, by Danna, in my clinic.

As the relative merits of arterioplasty as compared with the simple, obliterative, arteriorrhaphy of the aneurysmal orifices is unfortunately the phase of this operation which has been the least tested at the bedside, it is still a matter of considerable doubt as to what are its precise indications, more especially in view of the uniformly satisfactory results which have followed the intrasaccular suture of the orifices without arterioplasty. In view of the fact that the only instance of relapse in the entire series of reported cases occurred in one of the two aneurysms treated by arterioplasty, the tendency would be to look upon this method with suspicion as unreliable and of doubtful value as a permanent cure. But a careful inquiry into the details of the reported observations would not justify such a conclusion; and, furthermore, the failure

of one case in the presence of another, of identical character, which has thus far stood the test of time, would not justify any sweeping generalization and much less a condemnation of the method.

Dr. Morris' case was the first to appear after the publication of my paper and the first in which the lumen of the parent vessel (the popliteal) had been reconstructed out of the wall of the sac. This was a remarkable case in many ways, as is shown by Dr. Morris' very interesting account in the *Annals of Surgery* for October, 1903. In this case the choked-up condition of the circulation and great œdema of the limb were such that no hope could be entertained for the preservation of the limb, except by some method which permitted of the obliteration of the sac without interfering with the vascular supply of the limb. This Dr. Morris did with great skill on the lines suggested in my paper, and the immediate result was brilliant and extremely gratifying. I am confident that when relapse occurred two months afterward, by the dilatation of the newly formed channel, it would have been possible to have saved the limb and permanently relieved the patient by reopening the sac and suturing the orifices in the aneurysm, without attempting to reconstruct the artery a second time. In a personal letter to me, Dr. Morris writes: "A second operation similar to the first would seem to have been indicated, as the new aneurysm had begun at the upper part of the sutured line of the tunica intima, apparently at a point where I had not made the wall of the artery perfectly symmetrical with the suture. It seemed to be a defect due to my technique. Three-fourths of the sutured part of the intima seemed to have remained undilated. (I have the specimen). Reopening the sac and suturing of the nutrient orifices would probably have been effective in disposing of the aneurysm, but the patient preferred amputation, as one of his friends had a very satisfactory Mark's leg."

In Dr. Craig Barrow's case, operated on May 28, 1904, (a popliteal aneurysm) the artery was reconstructed as in Morris' case, and thus far no relapse has occurred.

There are two questions which arise in connection with the

reconstruction of arteries out of aneurysmal, and, consequently, diseased sacs: First, the possibility of relapse as in the Morris case, and, second, the possibility of obliteration of the newly formed artery by progressive endarteritis. Admitting these two possibilities, the result in either case does not necessarily impair the value of this procedure as a *provisional* measure in a certain group of desperate cases in which the vitality of the dependent parts, the lower limb especially, is endangered by an obviously defective collateral circulation and a choked-up condition of the extremity, as was evident in Morris' case. It is presumable that if the chief cause of circulatory obstruction is removed, by the collapse of the aneurysm, and the arterial supply is maintained by the restoration of the artery, the immediate peril of the situation will be bridged over and an opportunity will be given for the collateral circulation to develop effectively even if the artery does ultimately become obliterated by a gradual but progressive endarteritis.

If relapse occurs after a few months, it is always an easy matter to reopen the sac through the same scar, under local infiltration anæsthesia, if need be, and obliterate the orifices of communication by a typical endoaneurysmorrhaphy. By this time the circulation of the limb will have been sufficiently improved to practically assure its preservation. This thought occurred to Pantzer in deliberating over his case, and has no doubt occurred to others who have been similarly situated.

I am very far from admitting, however, that either one of the two alternatives mentioned must necessarily follow the reconstruction of an artery from the walls of the aneurysmal sac. It has certainly not occurred in Barrow's case which was operated[1]

[1] In a letter addressed to me and dated November 27, 1905, Dr. Craig Barrow writes:

"At this time Nathan Lott is alive and at active work, a cart driver. I have endeavored to see him personally, but so far have failed. About August 2 (1905) [15 months after the operation] I saw and examined his left leg. The popliteal space was free from any signs of aneurysm; the leg and foot were only slightly larger than the right, but no œdema. He was free from pain and stated that the leg was 'like it used to be.' There was some limitation of flexion; he could carry the leg almost at right angle with thigh."

on May 28, 1904, at least as far as I learned up to two months ago. We will also carefully watch Danna's case for further developments.[1] A great deal more evidence will have to accumulate on this question before a decisive conclusion can be arrived at; but I am firmly convinced that in traumatic aneurysms in healthy subjects, who are free from arterial disease, a permanently efficient artery could be reconstructed by the method of arterioplasty which I have described and which has been so brilliantly put into execution by the operators previously mentioned.

The more serious objection that suggests itself, after carefully considering the accumulated experience presented in this report, is based on the question whether there are any cases of peripheral aneurysm, with completely formed fusiform sacs, in such desperate straits, for want of collateral circulation, that they necessarily demand the preservation of the main trunk in order to save the limb. A fusiform sac, well formed, usually presupposes a long existence of the aneurysm, and, with this, a sufficient time for the development of a collateral circulation which is quite adequate to maintain the life of a limb, *provided the collaterals are not interfered with in the operation.* Whatever future observation may show, we may safely assert, as the result of our present collective experience with typical endoaneurysmorrhaphy (which always respects the collaterals) that, for all practical purposes, the preservation of the continuity of the main artery is not essential to success and that this feature of the operation—*i. e.*, preservation of the lumen—is only positively indicated in the sacciform aneurysms with a single opening and in which a formed, almost normal, vessel exists. In these cases the closure of the arterial fenestrum is necessary for hæmostatic purposes, and this can be accomplished usually with the greatest facility and security without interrupting the circulation in the underlying artery. The closure of such an orifice is per-

[1] While this paper is still in the printer's hands, the events in Dr. Danna's case have matured into a most instructive history, fully confirming (as shown by the clinical notes appended in the supplement) the belief above expressed, that even when relapse does occur after the reconstruction of an arterial channel in an aneurysmal sac (arterioplasty), it is quite easy to remedy the situation and cure the aneurysm by reopening the sac and obliterating the original orifice by suture

formed as easily in fact as in closing single perforations in the intestine; only more safely because there is, in the artery, no fear of fecal infection or gaseous leakage. In these cases it would be a surgical sin to obliterate the artery when it is so much easier to accomplish the object of the operation without interfering with its lumen. On this point our experience is unanimous, for in the four cases reported by Pantzer, White, Willy Meyer, and Markoe the local functional results could not have been more satisfactory.

One of the most important conclusions that may be drawn from the study of the 21 cases presented in this report is the general confirmation of the principles upon which the application of the suture to aneurysm is based. I contended in the paper of 1902 that an aneurysmal sac with its endothelial lining is, for all surgical purposes, a serous sac continuous with the intima of the vascular system. That regarded as such it would react as a serosa and could be expected to yield the same plastic reactions which have been so helpful to the surgeon in his interventions in the peritoneal cavity. Without repeating the arguments drawn from embryological, histological, physiological, and experimental evidence, so copiously furnished by the modern literature of the vascular system, especially in the more recent work on arterial repair and regeneration, it will be sufficient to refer to the clinical results obtained by the operators who have contributed their valuable and decisive experience in the past two years to confirm all my earlier expectations. The fear of secondary hemorrhage and lack of union from defective repair in altered or pathological tissue has not been borne out by our experience. Not only has the suture of the arterial orifices in the sac walls held firmly and permanently, thus securing permanent and efficient hæmostasis, but perfect union has occurred in spite of infection and suppuration in the wound in repeated instances. In securing the plastic union of the endothelial surfaces brought in apposition, no abrasion or refreshing of surfaces has been required; simply the approximation of the endothelial surfaces by the suture has been sufficient to bring about a prompt and permanent adhesion, just as we observe it in our routine peritoneal work. Plastic reaction with perfect occlusive union has been

obtained in all the reported cases, whether purely traumatic or pathological. In fact, in several instances, including my own, the sutures have been applied to distinctly atheromatous surfaces; in two, at least, plaques of calcic atheroma had to be brushed away to permit of the proper penetration of the suture. The danger of thrombosis has also been much exaggerated, because in all the cases in which the lumen of the parent artery has been restored (8 cases) there was evidence to show that the arterial stream had not been interrupted by the closure of the vessel. This bears out the view of Dörfler, Lindner, Israel, Salomoni, Tomaselli, Carrel and others, who, following in the wake of Murphy in arteriorrhaphy, have conclusively demonstrated that the through-and-through (perforating) suture of the arterial wall, if properly adjusted to the margins of the opening to be closed, is not followed in the large arteries, at least, by obliterating thrombosis, provided no raw surfaces are left in the interior of the artery and its lumen is not seriously encroached upon. As the method of endoaneurysmorrhaphy is indicated only in the treatment of the larger arterial trunks (femoral, popliteal, carotid, subclavian, axillary, and brachial) and the accessible large trunks in the abdominal cavity, the vessels involved are always of large calibre. Therefore, even if parietal thrombi should form over the inner surface of the suture line, they will ultimately become organized as plastic exudates and assist in protecting the line of suture while the process of repair is going on. An erroneous impression which still prevails in some quarters, to the effect that the older an arterial wound—*i. e.*, the longer the time that has elapsed since it has been inflicted—the less it is amenable to the suture, has been clearly controverted and disproved by our experience.[1]

We readily admit that pathological tissue undergoing degenerating changes is not an ideal material for the construction of a new blood channel, at least with the expectation that it may serve a permanent purpose. But our experience abundantly proves that

[1] See Legeau's report and commentaries on a case of suture of the popliteal artery reported by Le Fort (of Lille) in the Bulletin et mém. de la Société de chirurgie, Paris, December, 1903.

even atheromatous arterial coats, as seen in the margins of arterial orifices, do unite by plastic union when sutured, as firmly and solidly as healthy arterial coats, provided their endothelial surface is preserved.

In fact, one of the most notable demonstrations obtained by our collective experience is that the more fully formed and developed the aneurysmal sac, the more simple and satisfactory is the technique of obliteration of the arterial orifices by suture. The lateral or circular suture of a wounded (normal) artery is a delicate operation, requiring considerable technical skill and experience to do it successfully; but the suture of the orifices of an artery, as seen in an aneurysmal sac, is a comparatively gross affair which any one can do well who is competent to close an intestinal perforation. There can be no technical objection to arteriorrhaphy as applied to aneurysms; and the only physiopathological objections which previously obtained, and infused fear and distrust in the surgical mind whenever arterial injuries in connection with aneurysms were approached with the suture, have been dispelled by the facts presented in this report.

The curative value and permanency of the results have been tested by periods of time varying from eighteen years (my first case operated upon in May, 1888), and by an interval of nine months in the latest reported case (Abbe's, operated January 17, 1905). These results are in harmony with the end-results of arteriorrhaphy, notably illustrated by Djemil Pasha, of Constantinople, who in a recent communication to the Société de Chirurgie, Paris (*Bull. et mém.*, 1904, new series, vol. xxx. p. 718) reported the condition of three of his cases of arteriorrhaphy for accidental wounds of the axillary and iliac arteries. He had examined these patients recently, nine, eight, and four years after lateral suture (through-and-through silk suture) and found that the circulation had persisted normally in all the vessels, and that none of the patients had developed either secondary aneurysms or obstructive lesions.

Next to the closure of the aneurysmal orifices by suture the prompt obliteration of the sac itself, when its endothelial surfaces are brought in close approximation by sutures, is the best illus-

tration, on a larger scale, of the adhesive, plastic qualities of the vascular endothelium. The excellent results obtained by endoaneurysmorrhaphy also demonstrate that the endothelial lining of an aneurysm retains all its physiological and regenerative qualities when developed and spread as a new-formation in the interior of the sac, just as actively as in the interior of a normal vessel. The rapidity with which endothelial proliferation will transform an irregular, rough, adventitious space, created by extravasated blood poured into the tissues by a wounded artery, is remarkable; more especially if the orifice is large and the blood currents in the sac are very active.

In several cases a period of less than two months has been sufficient to provide a complete endothelial lining, with its characteristic smooth, glistening, and moist surface, for the interior of a cavity which occupied the entire popliteal space. The conditions which regulate or influence the rate of endothelial proliferation in traumatic false aneurysms have not been sufficiently studied; but, as this production of new endothelium from the intima in the edges of the injured vessel is a protective function, it is probable that the rate of endothelial proliferation is directly proportional to the size of the opening and the activity of the arterial current in the sac. These considerations are not irrelevant because in the past the tendency has been to look upon the sac as an inert, inactive, material; inimical to repair and something to be gotten rid of, if possible. Our experience has conclusively taught us that if the sac is not injured or detached from its vascular surroundings it is, in most instances, a valuable tissue which can be profitably utilized by the surgeon in fortifying the line of suture which cuts off the sac from the arterial current, as well as in obliterating the large cavity left in the tissues after the evacuation of the aneurysm. It is to be remembered, also, that the tendency of endothelial surfaces when excluded from the circulation is to unite and agglutinate by progressive proliferation if brought in close contact. This is well illustrated by the physiological occlusion of the ductus arteriosus, umbilical vessels, and other vascular relics of fetal life which become inactive after birth.

Treatment of the Sac. The preceding considerations lead to the question: Which is the best disposition that can be made of the sac, in the light of our present experience? In the paper of 1903, one of the essential features of the operation insisted upon was the principle of non-interference with the sac, and this has been faithfully adhered to by all the contributors to this report. I also detailed several methods which were applicable to different conditions met in practice, but laid special stress upon a method which might be referred to for convenience as the "typical method" because I had found it the most applicable and generally satisfactory in my practice. This technique was especially recommended for large aneurysms with fully formed sacs and pliable, relaxed walls.

*Method* 1. *Total obliteration of the sac by suture with inversion of skin flaps.* If we take a popliteal or femoral aneurysm, for example, we will usually find that after the evacuation of the blood and clot a large, deep cavity of variable size remains, showing the sac, at the bottom, thrown into longitudinal folds. These folds result from the relaxation of the sac and the perianeurysmal tissues after the tension from blood pressure has been removed. If such is the case, it will be the best practice to take up the lateral folds of the sac and bring them together toward the middle line by a continued catgut suture extending from one pole of the sac to the other. This row of sutures will not only reinforce the first line of hæmostatic sutures applied to the orifices, but will raise the floor of the sac to a higher level while reducing its dimensions considerably. If there is a surplus of material it will be practicable to contract the cavity still further by another tier of sutures, and in this way the level of the sac will be brought much nearer to the skin surface. Whatever remains of the sac then is turned upon itself with the superimposed and adherent skin flaps which result from the primary incision. In this way the cavity left by the collapse of the aneurysm is partially filled by the obliterated sac and partly lined by the flaps of skin which are held in position by suture. The object of this procedure is to leave no exposed raw surfaces or dead spaces and to bring into apposition as much

of the endothelial surfaces as possible. In this method no drainage is required. The details of the technique are best shown by illustrations which are presented in the original paper and have been reproduced in several well-known text-books on surgery. This "typical" treatment of the sac was applied, as originally described, in 8 of our 21 cases (Matas, 3; Bullock, 3; Barrow, 1; White, 1). The results were very satisfactory in all notwithstanding infection and suppuration in the wounds as far as the sac in 3.

*Method 2. Total obliteration of the sac by suture without inversion of the skin flap into the cavity.* In the paper of 1903 I stated: "When operating upon deep-seated aneurysms of the extremities or neck, it may happen that in stout, well-nourished or muscular subjects, especially when the femoral or popliteal regions are involved, the skin flaps will not stretch enough to reach the bottom of a deeply placed cavity, without excessive tension."

In such cases, rather than imperil the vitality of the skin by overstretching, it will be the safer plan to obliterate the sac itself with its own walls independently of the skin. The technique will then be the same as that described in the first or "typical method" as far as the obliteration of the orifices is concerned and the addition of the second protective row of sutures; after this, the excess of sac wall that remains above the second line of sutures may be either excised or inverted upon itself and the edges approximated by interrupted or continued catgut sutures. In this way the inner surface of the sac, including the orifices, floor, and lateral walls are thoroughly approximated, leaving the sac obliterated in the bottom of the wound. The overlying parts are then approximated and the wound closed without drainage in the manner preferred by the operator.

The total obliteration of the sac without inversion of skin flaps and without drainage, on the lines above indicated, has been performed eight times in the 21 cases reported, and in all with the most satisfactory results. In only 2 was suppuration observed per primam, followed by the most satisfactory functional and general results.

*Method* 3. In cases in which the sac is large and deep, with rigid bottom and walls, from adhesion of the underlying parts, as in some popliteal sacs which adhere to the posterior surface of the femur and ligaments of the knee-joint, the sac does not collapse or corrugate into plastic folds as is more often the case. In these conditions it is impossible to obliterate the sac by bringing together relaxed folds, and all that can be done to hasten the healing process after the suture of the orifices is to diminish the area of raw surface as much as possible by infolding the skin flaps into the bottom of the sac, as in the Neuber method of healing bone cavities, called by the French "capitonage." In deep cavities it may happen that the skin flaps will be inadequate to line the entire space, leaving the deep suture line exposed and uncovered. Relaxation incisions and other plastic methods which will permit the skin flaps to come together in the middle line may be tried, but are not desirable because of the additional traumatism and possible sloughing on account of the impaired circulation. It would be preferable to cover as much of the exposed surface as possible with the inverted skin flap, leaving the exposed surface in the centre protected by a layer of Cargile membrane or silver-foil, over which sterile gauze packing could be loosely applied in sufficient quantity to fill the hollow and to exercise gentle pressure upon the apposed surfaces until granulation had occurred. At the end of a week, when the dressings are removed, the granular surface, if extensive, can be covered at one sitting with Thiersch's grafts. No case of this type has been reported, though it is easy to conceive how the conditions described could occur in practice.

*Method* 4. In ruptured and infected aneurysms, where the intermuscular planes are extensively dissected by the extravasated blood, and where the primary sac cavity represents only a small part of the whole aneurysmal space, it is often impossible and undesirable to obliterate all the dead spaces left in the tissues after the evacuation of the clot. In these circumstances the better plan, after the obliteration of the orifices, is to close the sac separately by a secondary row of sutures above the hæmostatic line; then excise whatever part of the sac remains which has been

detached from its surroundings. The deep wound can be contracted in places by buried sutures and the remainder packed with sterile gauze.

Five cases of this type in which packing and drainage has been necessary after the suture of the orifices, or because the technique of the sac obliteration was not well understood (as in my first two cases) have been reported with final excellent results.

*Method* 5. The obliteration of aneurysmal sacs developed in the peritoneal cavity (iliac and others). The procedure suggested for these cases, described in my first paper, is not represented in our collection, as the application of the method to intra-abdominal aneurysm still awaits trial.

The preceding methods will probably suffice to meet the conditions in the majority of cases, but in atypical varieties each surgeon will modify the technique to suit the requirement of the case.

In regard to other minor details the reports show that the suturing of the orifices has been carried out chiefly by the continued method, the needle being applied through the entire surface of the margins of the orifices in order to obtain a firm grip of the basal membrane of the arterial wall and of the sac. The material used has been fine chromic catgut as recommended in my paper of 1902, and only in four cases has silk been used. Dr. Danna has applied purse-string sutures to the orifices in the sac, followed by a superimposed layer of interrupted sutures on the Lembert plan. In view of the simplicity and perfect security given by the continued sutures, the addition of purse-strings about the orifices would not appear to be specially advantageous. While very satisfactory results have been obtained with chromic catgut I would be tempted to try in obliterating the sac (not the orifices, for which I would still prefer the fine chromic gut) in future cases the glymol-iodine method of preparation devised by Dr. Willard Bartlett, of St. Louis. In addition to all the desirable qualities of durability, sterility, antiseptic impregnation, and tensile strength this material possesses the additional advantage of greater pliability and softness than is exhibited by other forms of gut with which I am acquainted.

The last question that I would submit for consideration is: How do the results thus far obtained by the present collective experience compare with the statistical results of the older classical operations which have thus far been applied to the cure of aneurysm? The claims that have been made for this operation are: (1) the simplicity of its technique which reduces the traumatism to a minimum; (2) its safety to the patient and to the parts involved because of non-interference with the collateral circulation, thus avoiding gangrene; (3) its permanency as a curative procedure, justifying for it the claim that it is a curative operation.

The results obtained in the cases reported in the supplement to this paper are the best answer to this question.

In comparing the new procedure of endoaneurysmorrhaphy with the ligature, the old operation of Antyllus, and the extirpation of the sac, which thus far have claimed first rank as curative methods in the surgical treatment of peripheral aneurysms, we find as to the ligature—which to the inexperienced might appear to be the simplest operation—that long observation and statistical evidence have plainly demonstrated that it is not as simple in its consequences as it would at first sight appear.

Delbet,[1] who, as the most eloquent advocate of extirpation in France, has made the most careful statistical study of this subject, has shown that in the preantiseptic period, up to 1888, the mortality following the ligation of the great vessels for aneurysm was 18.94 per cent.; the mortality after extirpation, 11.32 per cent., showing that even in the preantiseptic period the mortality of the ligature was greater than extirpation.

Gangrene following ligature for aneurysm (Delbet) up to 1888, 7.55 per cent.; from 1888 to 1895, 8.25 per cent.

Gangrene after extirpation up to 1888, 2.04 per cent.; 1888 to 1895, 2.77 per cent.

Asepsis has therefore reduced the mortality of the ligature as well as that of extirpation, but asepsis has been powerless

[1] Traité de chirurgie clinique et opératoire; LeDentu-Delbet; Tome iv. Bailliere, Paris, 1897.

to diminish to any great extent the dangers from local or peripheral gangrene, as this is dependent upon other than septic causes. It has been demonstrated statistically and clinically that the danger of peripheral gangrene in the extremities, especially the foot, increases with the distance of the ligature from the aneurysm; this is due to the frequent obliteration of the entire parent trunk from the ligature to the aneurysm and the consequent blockade of the branches that originate from it and that are instrumental in the collateral circulation. It also happens, as Delbet clearly explains, that partial or complete coagulation of the blood in the sac is often followed by a break-up of the clot, with a consequent plugging of the terminal branches emanating from the sac, as well as of the main efferent trunk by emboli, which are freed and discharged from the sac before the total arrest of the circulation has taken place. This is notably true of the popliteal aneurysms, in which the terminal portion of the popliteal artery, including its division into the tibials, is plugged with clot, accounting in this way for the disastrous gangrenes that are recorded in these cases.

In addition, it is a matter of record that the circulatory and neurotrophic phenomena which follow the apparent cure of aneurysms, especially the popliteal, after the ligature, in consequence of the presence and persistence of the aneurysmal tumor, still filled with organized clot, leave the patients often only partially cured.

In view of the fact that fully 71.5 per cent. (15 out of 21) of the aneurysms in which our operation of endoaneurysmorrhaphy has been performed are popliteal aneurysms, it will be only fair to take the treatment of this class as a basis of comparison with other classical methods of surgical treatment.

Quoting from Delbet again, we find that different methods of compression as applied to popliteal aneurysm, yielded as a group, up to 1888 (the preantiseptic period), the following results: 223 cases, 51.64 per cent. cured and 48.36 per cent. failures, including 13 deaths from gangrene and infection. Of the above 223 cases, 73 were treated by Reid's method, with 49.33 per cent.

recoveries and 50.67 per cent. failures, including 5 deaths (4 from gangrene).

*Digital compression* in 59 cases yielded 49.15 per cent. cured 50.85 per cent. failures.

*Flexion.* 49 cases; 36 per cent. cured; 64 per cent. failures, including 1 death and 2 amputations for gangrene.

*Operative treatment of popliteal aneurysms* from 1884 to 1894 (*aseptic period*) :

*Ligation* (Hunterian). 42 cases; 87.50 per cent. recoveries; 12.95 per cent. failures. Of the recoveries, 8 were imperfectly cured; 10.50 per cent. of these had gangrene of toes (5 : 48); 3 out of the 5 failures had gangrene requiring amputation of the leg.

*Relapses in Popliteal Cases.* According to Delbet, 4.50 per cent. of the cases ligated relapsed, and other methods had to be resorted to. In 15 per cent. of the reported cases the operation failed to give complete relief, because of the persistence of the tumor, though not pulsating.

*Radical Operation* (same period). 32 cases; extirpation (Purmann), 19; incision and pack (Antyllus), 13; results, no deaths. Cure of aneurysm in all.

*Local Results.* In 10.40 per cent. of the cases of extirpation, superficial gangrene of the foot in patches, not requiring amputation, occurred. In 8.33 per cent. of the cases operated by Antyllus, gangrene followed, requiring amputation.

Against these statistics we would oppose the result of our 21 cases of intrasaccular suture:

| | CASES. |
|---|---|
| Total | 21 |
| Popliteal | 15 |
| Femoral | 4 |
| Brachial | 2 |
| Mortality from the operation | None. |
| Gangrene from the operation | None. |
| Secondary hemorrhage | None. |
| Recurrence six months after reconstruction of the artery | One. |
| Recurrence after method of simple obliteration of orifices | None |

Oldest case (Matas), eighteen years since the operation: well.
Latest case (Abbe), nine months: well.

## Supplement.

### CLINICAL REPORTS OF CASES OF ANEURYSM

operated upon by the intrasaccular method of suture (endo-aneurysmorrhaphy) first presented by the author in the paper entitled "An Operation for the Radical Cure of Aneurysm Based upon Arteriorrhaphy," read at the meeting of the American Medical Association held in Albany, New York, June 1902, and published in vol. xx. of the *Transactions;* also in the *Annals of Surgery*, Philadelphia, February, 1903.[1]

Observation 1. Rudolph Matas, New Orleans, La. (Operator's first case.) This observation was published for the first time in full in the *Medical News*, Philadelphia, October 27, 1888, under the title "Traumatic Aneurysm of Left Brachial Artery, etc.," and is reported in abstract in the Transactions of the American Surgical Association, vol. xx., 1902, with the three following cases operated by the same author, where they may be consulted by those interested on the subject.

*Synopsis.* W. H., colored laborer, aged twenty-six years, admitted to the Charity Hospital, New Orleans, March 30, 1888. Two months before admission he was accidentally shot with a rifle; the whole load, consisting of fine birdshot, was distributed over the scapular, posterior acromial, and humeral regions, the gun being fired at a distance of fifteen feet from the patient. When admitted a large typical aneurysm of the brachial was recognized, which extended from a point three inches below the tendon

[1] This collection of clinical reports embodies the published cases which have appeared in the current literature since 1892 as they have come to the notice of the compiler, and also the unpublished observations which have been contributed by the various operators in personal communications to the author, who now thankfully acknowledges their courtesy and kind permission to give them publicity.

of the pectoralis major to one and a half inches from the bend of the elbow. Various methods of direct and indirect compression (Reid's Massachusetts Hospital compressor) were tried unsuccessfully. Then the brachial was ligated above the sac, but pulsation returned on the tenth day. Then the artery was ligated below the sac, but pulsation persisted. Upon opening the aneurysmal sac as a preliminary to extirpation, its rebelliousness to the ligature was explained by finding the openings of two large collaterals (superior and inferior profunda) which kept up the circulation in the tumor after the brachial had been ligated above and below the sac. The anastomotic circulation which accounted for this unusual condition is explained by a diagram which appeared in the original article. The aneurysm was of the fusiform type and extirpation was attempted, but had to be abandoned because of the great risk of injuring adherent nerves (median and ulnar) and brachial veins, which were incorporated in its walls. The walls of the sac were thick and strong and the openings within it so large and plainly exposed to view that I felt instinctively that the quickest way to obtain a permanent hæmostasis was by obliterating them with a continuous suture. This was done very readily by suturing the margins of the openings with an ordinary small, curved, surgical needle armed with fine silk, which absolutely obliterated the openings. A redundant portion of the sac was excised, leaving the floor and lateral walls undisturbed. The wound was partially approximated and packed with iodoform gauze. The cavity was partially approximated by sutures and partially packed. It healed partly by granulation. The patient was discharged well, May 21, 1888, with only a linear cicatrix to indicate site of aneurysm. The patient was seen in 1898, ten years after the operation. He was perfectly well and engaged in very laborious work on a plantation. The radial pulse was readily counted and nothing but a long, hypertrophied scar indicated the site of the former aneurysm.

Observation 2. Rudolph Matas, New Orleans, La. (Operator's second case.) Traumatic aneurysm of right brachial artery (gunshot), involving upper third of vessel in a man, aged thirty-two

years. Relapse two months after the ligation of brachial artery at its origin. Radical operation, April, 1900. Sac opened and found to be of the fusiform type, with two orifices communicating with the main artery, large enough to admit the tip of the index finger in each. Openings closed with fine continued silk sutures. Hæmostasis was complete after removal of constrictor. Sac partially closed by deep approximating sutures and partly drained. Wound healed three weeks after operation and patient, who lives in Central America, reports himself in good health and without sign of recurrence of his old trouble.

Observation 3. Rudolph Matas, New Orleans, La. (Operator's third case.) Large aneurysm of right popliteal (pathological). Male, white, aged twenty-seven years (alcoholic). After failure of various bloodless methods of treatment (compression and flexion) radical operation performed at Charity Hospital, November 15, 1900. Preliminary local and regional anæsthesia by exposure of sciatic in the popliteal space and intraneural infiltration of this nerve with cocaine. After free incision into sac, over a pint of red clot removed, revealing a single large opening leading to the popliteal artery. This opening was closed by through-and-through marginal silk suture, leaving the lumen of the artery intact. Then, in spite of a ligature applied to the popliteal immediately above the sac, the removal of the constrictor was followed by a free arterial flow from a diverticulum in the upper pole of the sac. The bottom of this diverticulum was then exposed and the opening of a large, bleeding collateral was sutured (catgut). The hæmostasis was then complete and the technique of sac obliteration by infolding its walls and inverting the skin flap into the remaining part of the cavity was fully carried out. A loose plaster-of-Paris roller was applied over a copious aseptic and sterile dressing. No circulatory disturbances followed and the patient was discharged from the hospital with his wound healed without suppuration in three weeks. When last seen, March 25, 1901, he was walking in the streets with good movements of the knee-joint, except a slight limp from adhesion of the skin scar to the gastrocnemius.

Observation 4. Rudolph Matas, New Orleans, La. (Operator's fourth case.) *Aneurysm of the left superficial femoral in the middle of the thigh; fusiform (traumatopathological) sac; suture of the arterial orifices; sac closed with inversion of its walls (regular technique of the author).*

M. B., negro laborer, aged forty-five years. Admitted to the Charity Hospital, March 25, 1901. Probably syphilitic. Large femoral aneurysm of probable traumatopathological origin. After failure of digital compression, operation by the author's method on March 30, 1901. Chloroform. The femoral was exposed below Poupart's ligament and provisional silk ligatures passed around it. Incision into the sac followed by a gush of blood and a little clot. A sacciform aneurysm was revealed with two openings in the bottom of the sac, separated by an interval of two inches. The openings were large enough to admit the index finger for a distance of one inch into the lumen of the artery. In spite of vigorous traction on the femoral artery with a traction loop there was a steady and free flow of arterial blood from the distal orifices, which only ceased after suture of the orifices. The proximal opening was also sutured and the hæmostasis was complete. Evidently there was a large collateral emptying into the distal end of the femoral a short distance outside of the opening of the main trunk into the sac. After complete hæmostasis had been secured by fine catgut sutures, the provisional traction ligature loop on the femoral was removed and the small wound closed. The sac was then obliterated by infolding its walls and by inverting the skin flaps into the hollow left by the closure of the aneurysmal sac. After a copious sterile dressing had been wrapped around the entire limb a pasteboard splint was applied and the patient sent to bed in excellent condition. Pulse 86, and with the limb warm. He made an uneventful recovery and was discharged in good general health and with only a depressed scar to show the site of the former aneurysm. He left the hospital May 13th, after acting as help in the ward for several weeks.

Observation 5. Dr. W. O. Bullock, Jr., Lexington, Ky. (Operator's first case.) Reported in *American Medicine*, vol. vi., No. 9, pp. 364–366, August 12, 1903, under the title of "The

Matas Treatment of Aneurysm, with Report of a Case." This is the first operation performed by this method after the publication of my paper in the TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION, 1902, vol. xx., and is the first of three cases successfully operated upon by Dr. Bullock; the other two (Nos. 12 and 13 of this series) were reported in personal communications to the writer, and now appear for the first time by Dr. Bullock's kind permission.

*Traumatic Aneurysm of Femoral; Fusiform Type.* E. C., aged thirty-five years, is a short, muscular, and well-nourished negro. He was admitted to St. Joseph's Hospital February 18, 1903, and gave the following history: While moving some household effects in September, 1902, a mattress fell from the wagon. He was thrown on the mattress and a wheel of the wagon passed over his thigh. Shortly after the accident he noticed a small lump, the size of a walnut, on the inner side of his thigh at the point of injury. The knot was painful, but did not prevent the patient's working. It grew slowly, and a month ago was about the size of a goose-egg. From this time on the growth was very rapid, increasing to its present dimensions. The increase in pain was correlative with its growth, rendering the patient unable to work at his occupation of laborer.

The present condition shows an otherwise healthy negro, presenting on the inner side of his right thigh a mass corresponding about to the middle two-fourths of the femur and about the size of a large cocoanut. The temperature is normal and pulse 110 to 120, and irregular. On account of the position of the original lump (over the femoral artery) more than anything else, together with the history of the increase in size, a diagnosis of probable aneurysm was made, though at the operation I was prepared to amputate should the tumor prove malignant. On February 23, 1903, under ether anæsthesia, the circulation of the limb being completely controlled by an elastic tourniquet, a vertical incision seven to eight inches long was made over the prominence of the mass, and an aneurysmal sac was entered. The clots and some fluid blood were turned out; the contents measured at least a

quart. On inspection of the cavity that had been filled by the clots, it was seen that over its most superficial part the intima was not complete; either it had been torn away in detaching the adherent laminated clot or the growth of the tumor had been so rapid that the wall of the cavity had not had time to assume an endothelial character. The openings of the femoral artery were seen in the bottom of the sac, separated by nearly an inch. The sac was washed out with normal saline solution, and rubbed quite vigorously with gauze sponges. The openings of the artery were closed by sutures, No. 2 chromicized gut being used, the technique of the operation as advised by Matas carried out fully, folding a second layer of aneurysmal intima over the first. This reduced the size of the sac more than I could have believed possible. The tourniquet was now released; there was absolutely no bleeding from the sac and but little oozing from the cut edges superficial thereto. The floor of the sac was now brought into apposition by retention sutures, two on each side, and the skin wound closed by a continuous catgut suture. The operation took forty-five minutes. The patient left the table in good condition, and was put to bed with an elastic tourniquet thrown loosely around his thigh above the wound.

The patient ran a little temperature (the highest 100.4°) for three days, when it fell to normal and remained there. Relief from pain was prompt and continuous, circulation in the leg was good, but slight stinging was complained of for several days. Wound was dressed first on March 1st. About two drachms of bloody serum escaped from the lower end of incision, there was also some infection about the skin sutures. The wound continued to discharge a little seropurulent fluid from the lower angle for several weeks, when it finally ceased altogether. The patient was allowed to get up after three weeks, and after another week was assisting the orderly in his work about the ward. When I saw him last, on April 2d, the wound was completely healed, a hard, painless disk occupying part of the space that was formerly occupied by the tumor. The infection in this case came, I believe, from the skin, which was tense and inflamed over the prominence of the

mass, and from each stitch-hole at the time of the first dressing there exuded a drop of pus.

In a personal letter dated July 14, 1904, Dr. Bullock states: "I saw my first patient (reported on February 23, 1903) a short time ago and a smooth linear cicatrix is the only evidence of pre-existing aneurysm (fourteen months after operation)."

Observation 6. Dr. Robert T. Morris, M.D., New York, operator. *Annals of Surgery*, October, 1903, v. xxxviii., No. 4, under title: "Notes on a Case of Fusiform Aneurysm Treated by Matas' Method." (Abridged from original report.)

The patient was a strong, robust man, G. H., aged fifty-eight years, who had been in the habit of sitting, when reading, with the right leg over the arm of his chair. He noticed that this often caused pain in the popliteal region, and he had apparently caused sufficient traumatism of the popliteal artery to endanger the integrity of its coats. No other part of his history seemed to have a bearing in the case. During the past four years a swelling in the right popliteal region has been increasing, until at the time when I first saw the patient the aneurysm was so large that its pulsations were visible on both sides of the knee, when viewed from the patellar side. Lymph stasis in the leg was so marked in degree that the leg was tense and swollen, although it had been tapped several times to allow the œdema to subside. It seemed to us that a ligation of the femoral artery would be particularly dangerous in the case, on account of the condition of the blood and lymph vessels of the leg, and it was decided to attempt to give relief by the Matas method. The operation was performed at the patient's home in Sound Beach, Connecticut, on May 16, 1903.

An elastic bandage was applied from the foot to the thigh and secured at a convenient point above the site of the aneurysm. An incision ten inches in length was carried longitudinally through the tissues of the popliteal space, and this included the wall of the sac of the aneurysm. A double handful of clots was removed from the sac, and the aneurysm was determined to be of the fusiform type, with a large, thin-walled diverticulum which constituted the

chief part of the mass. With No. 1 chromicized catgut a running suture was carried through the tissues of the deepest part of the sac in such a way as to construct something more than three inches of new artery of a calibre estimated to be similar to that of the normal artery, and a second row of sutures was introduced for fortification. The remainder of the sac was left undisturbed and still adhering to its surroundings. The new artery was held between my fingers when the elastic bandage was removed from the thigh, and it was a moment of considerable interest. Pulsation bounded through the new artery, and it did not leak at any point. The patient's foot became warm, but it was not possible to find pulsation in the arteries of the foot on account of the tension of the œdematous tissues. The wound was closed without drainage, and it healed completely by primary union. The swelling of the leg began to subside immediately after the operation, and assistance was given by massage administered by the trained nurse, who remained constantly near the patient for the first few days.

Paralysis of sensation and of motion which had resulted from the presence of the aneurysm began to disappear shortly after the operation. Sensation was well defined over the right leg and foot by the seventh day. By the twenty-second day, when the patient was first allowed to sit out of bed, the only important paralysis of motion remaining involved the anterior tibial group of muscles, and this is improving under treatment. On the twenty-second day the site of the aneurysm was carefully examined for the first time. The newly constructed artery gives the impression of being larger than the popliteal artery of the left leg. Whether this is due to the thicker walls of the new artery, or whether I did not estimate quite closely enough on the calibre of the normal artery, it is difficult to say. In any event, the restoration of function is satisfactory.

*Notes on Subsequent History.* In reply to a letter of inquiry addressed to Dr. Morris, he kindly wrote on April 7, 1905, as follows:

"In the case of aneurysm of the popliteal artery, of which I gave an account in the *Annals of Surgery*, October, 1903, it was

necessary to do a secondary operation six months later, but the patient preferred amputation, as I told him frankly that we were experimenting. He stated that about two months after the first operation it was noticed that there was a progressive swelling in the popliteal region, but he did not call his physician's attention to it. Six months after the first operation the new aneurysmal sac was about one-fourth (estimated) as large as the original aneurysm, and disability from pressure upon the blood and lymph vessels began to be in evidence. I amputated at the knee, and the wound healed by primary union. Answering your questions seriatim. A second operation similar to the first would seem to have been indicated, as the new aneurysm had begun at the upper part of the sutured line of the tunica intima, apparently at a point where I had not made the wall of the artery perfectly symmetrical with the suture. It seemed to be a defect due to my technique. Three-fourths of the sutured part of the intima seemed to have remained undilated (I have the specimen).

"Reopening the sac and suturing of the nutrient orifices would probably have been effective in disposing of the aneurysm, but the patient preferred amputation, as one of his friends had a very satisfactory Mark's leg."

Observation 7. Rudolph Matas, New Orleans, La. (Operator's fifth case.) From ward notes by Dr. Jules Lazard in Tulane *Phagocyte*, December, 1903, p. 34. *Left popliteal (traumatopathological) aneurysm, fusiform type; large diverticulum on outer side, under biceps; orifices obliterated by suture without arterioplasty; recovery.*

F. G., colored male, painter; married. Exceptionally good family history. Had gonorrhœa twenty-one years ago. Three years ago had syphilitic chancre. Has taken four drinks of whiskey daily for twenty years; uses claret and beer also, but not as regularly as whiskey.

In June, 1903, he fell thirty-five feet, striking his leg. The fall, however, was not so severe as to disable him from his work. About September 1, 1903, three months after fall, he first noticed a dull, aching pain about the region of the knee, the pain being more

severe at night. The pain became progressively worse, but he continued his work, attributing his pains to rheumatism.

On October 20, 1903, he entered the Charity Hospital (Dr. Matas' service). Physical examination good. Heart slightly enlarged and the first sound at the apex slightly accentuated. Urine normal in quantity and quality except a few hyaline casts. Evidences of general arteriosclerosis. Examination of left popliteal space shows an irregular, expansile tumor occupying the entire space. The following are the measurements: Length, 5.5 inches; transverse diameter, 6.5 inches. It has a diverticulum beneath the biceps muscle. Circumference, 14.5 inches. When pressure on femoral stops pulsation and bruit, it measures $13\frac{3}{4}$ inches. After a preliminary rest; operation November 7, 1903. Chloroform anæsthesia. The behavior of the patient in the stage of excitement confirmed the personal history regarding the use of alcoholics. Esmarch bandage from toes to upper part of the thigh; constrictor applied. Incision of skin to sac; this was carefully located and opened. Clots removed, excellent specimens of laminated clot, and red clot over two handfuls. Wall of sac found to be very fragile; tore when slightly pulled on by dissecting forceps. Upper and lower openings located, the upper presenting a funnel-shaped appearance. The aneurysmal orifices were closed with fine chromic gut No. 1 continued suture, Lembert plan. An interval of over 2.5 inches separated the openings which were seen at the bottom of the sac. The diverticulum under the biceps was scrubbed off with sterile gauze moistened with saline solution. No attempt was made to reconstruct the artery on account of poor condition of the walls. A double tier of buried catgut sutures contracted the sac and infolded the walls over the sutured orifices. The sac itself was very carefully handled in order to disturb the collateral circulation as little as possible. The constrictor being removed, the bottom of the cavity remained practically dry.

The skin flaps were turned into the sac as in Neuber's method of healing bone cavities. The flaps were held in place by interrupted catgut sutures and a gentle sterile dressing which filled the depression and was held in place by adhesive straps. A

copious, aseptic dressing of cotton batting to the entire limb covered over with plaster-of-Paris roller from toes to groin. The circulation was good immediately after the removal of the constrictor. No pulsation in dorsalis pedis, but color and heat good. Surface suppuration followed, requiring a fenestrum in the cast. Patient was up and walking about in about five weeks. He was retained as a help in the ward for several weeks, with a perfect functional result. A dense linear cicatrix marked the site of the original incision. He reported to the clinic March 6, 1905, seventeen months after the operation, in excellent condition and working at his trade as usual.

Observation 8. Dr. J. F. Binnie, Kansas City, Mo., operator. Published under the title of "The Matas Treatment of Aneurysm," *Journal of the American Medical Association*, vol. xlii., June 25, 1904. *Popliteal sacciform (pathological) aneurysm.*

J. K., aged fifty-two years; laborer; fairly hard drinker, as evidenced by his statement and face. Several attacks of gonorrhœa. Syphilis at thirty-seven, with apparent cure under treatment. When twenty-five years old was confined to bed for six months with rheumatism; has had no recurrence of this. Developed an inguinal hernia three years ago, for which he wears a truss. Two years ago he suffered from an acute pain shooting down the calf of right leg. Tumor soon appeared in calf; had increased readily in size and been diagnosticated as rheumatic, tuberculous, etc.

The affected calf measured eighteen inches in circumference (the normal one being twelve inches). There is an expansile pulsating tumor of the calf, reaching up to the popliteal space. Well-marked bruit in tumor. Posterior tibial pulse delayed. There is no tenderness and only a little pain referred to the foot. Diagnosis, aneurysm.

*November* 10, 1903. Sisters' Hospital. Chloroform; elastic constrictor. Incision into tumor through the attenuated gastrocnemius showed a cavity six by three inches in diameter, largely filled with a very dense, lamellated, fibrinous mass. This was removed. The aneurysmal sac was thick walled and markedly atheromatous. Only one opening into the sac could be found, and this was closed

with catgut sutures. The whole sac was obliterated by many layers of catgut Lembert sutures and the superficial wound closed without being inverted. Dressings were applied and the patient returned to bed with his leg much elevated before the elastic constrictor was removed.

17*th*. A slight elevation of temperature led me to change the dressings, when some blood and pus escaped from the wound. There was no pain or redness. Drainage and cleanliness led to recovery. Up to date there has been no recurrence.

The above case was evidently one of sacculated aneurysm. Efficient circulation was promptly established, but the posterior tibial pulse can no longer be felt. The suppuration was undoubtedly due to some avoidable contamination acting on non-resistant tissues.

OBSERVATION 9. Dr. Craig Barrow, Savannah, Ga., operator. (Georgia *Practician*, No. 4, April 15, 1905.) *Popliteal (pathological) aneurysm; fusiform; artery reconstructed by arterioplasty.*

N. L., colored, aged sixty-eight years; widower.

*Past History*. Very indefinite. No history of rheumatism; denies syphilis; had gonorrhœa; three years ago had small aneurysm removed from right ankle; has always been a cart driver; moderate use of alcohol; has three full-grown and healthy children.

*Family History*. Indefinite. Can get no history of aneurysm.

*Present History*. Some time during December, 1903, he noticed a small "lump" under left knee, about the size of little finger; no pain, but knee would feel stiff early in the morning, limbering up during the day; some pulsation noticeable to patient. The "lump" hardly increased in size for two months; then he began to feel pain, more at night; knee would be quite stiff in the morning; continued to do regular work; at times his left foot would "go to sleep;" the whole left leg would tingle and feel numb; the "lump" would pain and throb more at this time. About the middle of March, 1904, his left foot and leg began to swell; the "lump" grew rapidly; knee began to get stiff, partially flexed; could not fully extend the leg; pulsation noticeable all the time; pain intense at night; gave up work and went to bed on May 1, 1904; entered hospital May

11th. He is a well-developed man; chest and abdomen normal; left leg flexed upon thigh, angle 30; ankle, foot, and leg were swollen and œdematous. On examining popliteal space all visible signs of aneurysm were very apparent; both subjective and objective signs indicated a fusiform aneurysm.

*Operation, May* 28, 1904. Usual technique. Esmarch bandage applied from knee to thigh; incision made over median line of tumor; freed mass, finding the joint intact. I opened aneurysm longitudinally, removing and washing out clot; fibrin scraped out; all openings into sac, excepting two main openings, were closed with interrupted sutures of chromic gut; I then placed a portion of rubber catheter in inlet and outlet, occupying the natural groove; in suturing sac over this, I used silk and chromic gut (the latter is preferable); fourteen interrupted sutures were placed immediately over the catheter, piercing the aneurysmal wall from within, out and back again, to be tied on inside; they were tied as directed in the Matas operation. The Matas procedure was followed throughout the entire operation in placing the tiers of sutures, excepting I used the subcutaneous tissues in supporting the walls of the sac and not the skin and subcutaneous tissues together. I supported the new wall with three large chromic retention sutures; then the skin was sewed up; a tight-fitting bandage applied before removing Esmarch. On the third day pulsation was perceptible at ankle; patient was relieved of pain and throbbing behind the knee and the passive congestion began to diminish; there was a slight skin infection, which healed readily.

This man has been under my observation since May 28th, the day of the operation. He can flex and extend leg; walks without assistance; has no visible or subjective pulsation on popliteal space, and no pain; the left leg is practically the same size as right.

"I agree with Dr. Matas in advising the obliterating operation in preference to attempting arterioplasty. It is far safer and the result will be equally as satisfactory."

On November 20, 1904, Dr. Barrow wrote: "This patient has been under my observation since May 28th (six months). He can flex and extend leg; walks without assistance; has no visible or

subjective pulsation in popliteal space; no pain, and his left leg is practically the same as the right."

On November 27, 1905, Dr. Barrow reported this patient had continued well and without sign of relapse.

Observation 10. Dr. Hugo O. Pantzer, Indianapolis, Ind., operator. Published in the *Lancet-Clinic*, Cincinnatti, Ohio, May 13, 1905, new series, vol. liv., No. 19. "Report of a Case of Popliteal (Traumatic) Aneurysm, Treated by Arteriorrhaphy." (Abridged from original report.)

Mrs. M., American, aged fifty-nine years; farmer's wife and mother of a large family. Patient, thirteen years ago, was shot transversely through the thigh just above the knee-joint. A large hæmatoma developed which reduced gradually, leaving a swelling in the hollow of the knee which beat like a "little heart."

Three years ago, during a physical strain, patient was suddenly seized with pain and swelling at the old site and months passed before this swelling subsided. Six weeks before examination pain and swelling increased rapidly, growing worse until examination May 9, 1904, when a ruptured traumatic aneurysm complicated with pyelitis and cystitis was recognized. Patient showed evidence of bad assimilation. Temperature, 102.2°; pulse, intermittent, 90 to 152. Urine, specific gravity 1008, scant, acid, contained pus, pyelar and bladder epithelia. With rest in bed pain grew less; swelling did not increase and urinary trouble improved. Pulse stronger, though variable, 80 to 135.

*Operation*, May 30, 1904. Chloroform. Ischæmia with Martin's bandage from foot to swelling at knee, and a second bandage beginning over upper part of swelling to Scarpa's triangle; Esmarch's tourniquet. Incision in median line posteriorly over entire length of swelling. Beneath deep fascia blood was found. The blood was mostly clotted; some semiorganized in various stages. The blood was scooped out. It filled a two-quart pan, being found everywhere in the interspaces between muscles and fascia. No pus was found. The popliteal artery in the bottom of the wound had an irregular opening in it measuring three-fourths of an inch in its greatest length and five-sixteenths

at its greatest width. The parts adjacent for an inch or more were covered with a thickened layer adherent to its base, suggesting a semi- or poorly organized blood much devitalized and partially necrotic. This was covered more or less with a dull, glistening membrane, continuous with the intima of the vessel. The margins of the popliteal opening showed this lining in best condition, though distinctly membranous parts existed only in two little flaps or tags one-eighth of an inch wide on one side of the opening and one tag of the same size on the opposite side. Anything like a sac wall was absolutely wanting. The arterial wall adjacent to the opening had little hard plates with ragged sharp edges upon it, evidently calcareous deposits. For the moment it seemed the case was not amenable to sewing, owing to atheromatous arterial wall. Also Matas' suggestion to plait the sac to fortify the arterial suture was not feasible. There was no sac wherewith to do this. Ligature of the artery according to classic methods, in the present condition of the limb, was sure to be followed with gangrene of the limb. While passing the finger over the margins of the popliteal opening some of the calcareous matter came away. Examination revealed almost all of it to be scaly and removable. After its removal there was found a hard though not entirely unpliable tissue. Upon this finding I decided to sew up the wound as in simple arteriorrhaphy. Even as a temporary expedient it seemed justifiable. With a competent nurse at the bedside constantly and everything prepared for an instantaneous operation, a dangerous turn or leakage, I calculated, could be detected in time to avert disaster. The improved circulation through the limb, if even for a day or two only, would make ligature, if it subsequently became necessary, more hopeful as regarded life and limb.

The popliteal vein, as, indeed, all the finer structures of the knee-pit, could not be made out. These parts were covered by the semi-organized, much devitalized membrane, or sac wall, in a manner precluding much tentative manipulation. A Van Horn No. 1 twenty-day chromatized catgut was used in continuous suture to close the popliteal artery. I decided to trust to the apparently fair condition of the endothelial lining at the margin of the wound.

A longitudinal suture would have materially reduced the calibre of the vessel; so I decided to sew the opening somewhat transversely, as is done in the Mikulicz-Heincke operation for stenosis of the pylorus. The effect obtained was satisfactory. The sewed vessel, if anything, seemed wider in calibre at the point of suture. A fortifying suture near each end was placed, but these gave little additional support because of the scarcity of tissue available. I had not determined the location of the popliteal vein. Even though the sac wall had been less friable the failure to unravel the anatomy made sewing impracticable.

Immediately after placing the sutures described the tourniquet was loosened. The artery within a few seconds began to show life, and directly pulsated normally. There was no leakage.

The large cavity formerly occupied by the extravasated blood was now thoroughly irrigated with salt solution, mopped dry, and packed with mild iodoform gauze. The incision of the skin was closed with sutures above and below, leaving unsutured two inches over the popliteal artery. An abundant gauze and cotton dressing was applied tightly with roller bandage and the limb fixed by a plaster-of-Paris dressing with the knee at an angle of above 110 degrees.

Patient's pulse and temperature for days continued about the same as immediately before the operation—*i. e.*, 98.4° to 100.2°, pulse 84 to 128. These passed without greater trouble arising.

The leg and foot of the diseased side was complained of during the first twenty-four to thirty hours. There was occasional darting pain and pricking sensation. Wound was dressed forty-eight hours after operation. Gauze packing was removed. The wound was dry everywhere except at one point high up on the thigh, where a slight venous hemorrhage had occurred. Strands of chromatized catgut were placed in the wound for drainage. A gauze roller compression bandage was applied over limb, and the limb fixed with plaster-of-Paris splints. At the next dressing, five days later, the wound was found healed. No evidence of retention. Drains were left *in situ*. Circulation of limb normal.

On tenth day the bladder and urinary symptoms were found

worse. Temperature by axilla 100°. Patient became slightly delirious. The following day the temperature rose to 103°, pulse at times 120. Patient had much pain in bladder and back and required morphine repeatedly. On twelfth and thirteenth days conditions grew worse, temperature 104.3°, pulse 134. On fifteenth day *exitus letalis.*

*Postmortem* was confined to leg. External wound had healed perfectly. Death was ascribed to pyelitis and cystitis. The resected portion of the poplitea shows a perfect closure over the former opening. The poplitea on its posterior surface was covered with the deep fascia and fatty tissue of the skin, in firm adhesion to it. This shows that, with compression applied, these parts may be relied upon to give support where the aneurysmal sac is not available for such purpose.

The artery as seen from within shows the calibre actually wider at the seat of suture than above and below. The tissues of the artery wall give evidence of advanced atheroma. There is a cup-shaped depression at one point by the side of the suture. Notwithstanding this evidence of a bad arterial wall, the suture held.

What would have resulted had the patient survived the kidney disease is disputable. Possibly a thrombus would have covered in the weakened point. Possibly a new idiopathic aneurysm would have developed in time. But be this as it may, it seems justifiable to conclude by the experience of this case:

1. That traumatic aneurysm is amenable to suturing.

2. That even much atheromatous degeneration of the artery wall does not necessarily contraindicate suture, at least as a temporary expedient.

3. That fortifying folds of aneurysmal sac are not absolutely necessary.

4. That early surgical interference in these cases seems clearly indicated.

Observation 11. Dr. Herman B. Gessner, New Orleans, La., operator. *Annals of Surgery*, Philadelphia, January, 1905. "The Matas Operation for Aneurysm; Report of a Case of Popliteal (Pathological) Aneurysm so Treated."

A negro, aged thirty-two years, was admitted to the Charity Hospital of New Orleans, June 21, 1904, with an aneurysm of the right popliteal artery, involving the middle and lower portions of that vessel. The tumor was five inches in the long axis of the limb by four and one-quarter inches transversely. He gave a history of syphilis four years before, with one year's treatment. First noticed pain and swelling in the limb two months before admission.

*June* 23, 1904. With an Esmarch constrictor in position, an incision was made in the median line posteriorly; this exposed the internal popliteal nerve, which was retracted inward. The incision was now carried through the aneurysmal sac. No clots whatever were found. The interior presented a thin layer of laminæ and fluid blood. The lower opening was found early, being quite superficial and to the inner side; dark blood was escaping from it in small quantity. This opening, which was quite oblique, was at once sutured with a continuous Lembert suture of No. 1 chromic catgut. After a prolonged search, during which the sac was split up to its full extent, the upper opening was found directly above the lower at a distance of one inch. (The aneurysm had evidently developed toward the anterior and external aspects of the artery.) It had been hidden from view by a fold of the sac; dark blood was escaping from this opening also. No. 3 chromic catgut was used in the form of a continued Lembert suture for the closure of this orifice. Removal of the constrictor was followed by escape of bright arterial blood above, showing either that the closure was defective or that some collateral existed, the opening of which (quite near by) had escaped detection. Complete hæmostasis was effected by a massive Lembert suture taking up at least an inch bite of sac wall on either side. The result of this step was the firm approximation of the walls of the aneurysm in the upper third, with a resultant approximation of the remaining two-thirds of the sac wall, so that no Neuberizing was necessary to do away with any dead space. A small iodoform gauze drain was introduced into this lower, unsutured portion of the aneurysmal cavity. The skin wound was narrowed with silkworm gut. At

the termination of the operation pulsation could not be felt in the dorsalis pedis. The usual aseptic gauze and cotton dressings were applied, with a cardboard gutter-splint posteriorly. The foot was elevated about four inches. First dressing four days later; a moderate infection existed; iodoform pack replaced by a smaller one. Foot warm; pulsation perceptible in dorsalis pedis. The infection diminished steadily; patient sat up July 21st; on August 15th his wound was entirely well. There was no pulsation whatever; a slight tendency to œdema was observed.

Examination on September 3rd showed the following condition of affairs: Patient in excellent health. General appearance of limb good; walks with a little stiffness (has been walking moderately since August 15th); scar hypertrophied, with a little erosion due to friction of clothes and bad management of scab. Circumference of limb at middle of scar fifteen and three-eighths inches as against fourteen and three-eighths inches for opposite limb at same level. This difference is attributable to the hypertrophied scar on the one hand, and on the other to the presence of the aneurysmal sac, which was left *in situ* at the time of operation. To the outer side of the lower quarter of the scar is a non-resistant swelling, which I take to be a venous dilatation, probably in the upper portion of the external saphenous. Neither here nor elsewhere in this region is there any sign of aneurysm. Pulsation is palpable in the dorsalis pedis, not in the posterior tibial behind the malleolus.

Note. Since this report has appeared the patient has been examined by Drs. Gessner and Matas and there is no appearance of relapse; hypertrophied scar remains, but there is no enlargement or pulsation in the space. The functional use of the knee is perfect and the patient is able to attend to his laborious duties without impediment.

Observation 12. Dr. W. O. Bullock, Jr., Lexington, Ky. (Operator's second case.) Personal communication dated July 14, 1904. *A case of popliteal (pathological) aneurysm; fusiform.*

Ben. B., colored, aged fifty years, for past thirty years has been employed in a stove and tin store and accustomed to lift heavy

weights—was constantly putting his strength to severe tests. About one and one-half years ago without definite injury he began to suffer with pain in the left leg and to notice that the leg at the knee was considerably enlarged. He "doctored" himself for rheumatism and consulted a physician only after several months had elapsed. He was referred to me about fifteen months ago. At that time he was still at work. All signs of popliteal aneurysm of moderate size were unmistakable. Operative suggestions dismissed without consideration. I did not see him again until June 13, 1904, when the pain in his leg had become so constant and severe that he visited a number of physicians asking that the "abscess" be lanced. Fortunately his request was denied. He again fell into my hands, with condition as follows: Tumor greatly enlarged, measuring six by four and a half inches; skin stretched and glossy over surface; arteriosclerosis of moderate grade; no history or other evidence of syphilis. Blood pressure, anterior tibial artery: left, 139 mm. (Hg.); right, 170 mm.

*Operation, June* 14, 1904. Ether. Tourniquet placed around thigh broke and was again put on, as I thought, tightly enough. Sac incised freely, clot turned out, bleeding profuse. It then was plain that the ligature was inefficient, so with an assistant making firm pressure against the openings from within the sac I extemporized a tourniquet by using tubing of an irrigator which had not been previously sterilized. Immersing my hands for a minute, more or less, in bichloride solution did not, as I might have known, suffice to disinfect them, but I proceeded with the operation. I found two openings of the artery on the outer wall of the sac, much nearer the superficial than the deep surface of the sac. The sac itself was covered for a large part of its extent by a fibrinous layer that could not be detached by scrubbing, and its walls quite friable. The openings were closed as advised, taking considerable amount of tissue at each bite to prevent cutting through of the sutures. The deeper walls of the sac were apposed from side to side. The skin was not held down by suture. There was no hemorrhage from the sac on removing the tourniquet. The sac was large (holding probably a quart) and considerable time was required to

complete the side-to-side approximation. Skin wound closed. Silkworm gut. Duration of operation one hour.

The day after operation the temperature was 101.8°, pulse 86. Some pain about patella. The second day his temperature was 102.5°, pulse 80. Still complained of knee. I opened front of dressings and found a very tender spot at the lower border of patella and some accumulation in the prepatellar bursa. Hoping that this might be responsible for his temperature, I did not change the dressings until the following day, when his temperature was 104° and pulse 100. I then found the skin distended and black, stinking pus exuding from between the sutures. Opened freely. Probably one and one-half ounces of pus escaped. Gauze drainage pushed down deeply into the sac.

The discharge continued free for four or five days, then became less and less, and finally ceased. The temperature rapidly fell to normal and never rose above it. Pain likewise disappeared. At the present time there is but a clean, granulating surface three inches long, one-quarter inch wide, and flush with the skin. Patient is up, walking about, and feeling fine. I kept a tourniquet loosely about his thigh for nearly three weeks and an orderly was constantly with him. It was my intention and desire in this case to restore the continuity of the vessel and during the period of repair to test its efficiency as indicated by the sphygmomanometer, but the aneurysm, though sacculated, presented two openings separated by nearly an inch and the walls of the sac too thick and friable to consider doing the plastic operation of repair. Aside from being an unusual form of fusiform popliteal aneurysm the case is of interest because I believe it tested to the limit the efficacy of the endoplastic suture.

Observation 13. Dr. W. O. Bullock, Jr., Lexington, Ky. (Operator's third case.) Personal communication dated June 6, 1905. *Popliteal aneurysm (traumatopathological); fusiform.*

W.B., a negro laborer, aged thirty-four years; syphilitic; admitted to the St. Joseph's Hospital, Lexington; service of Dr. Bullock, for the treatment of a popliteal aneurysm of spontaneous origin with no distinct history of trauma except "strain of the popliteal vessels

in hard work associated with syphilitic arterial disease." The tumor and pulsation noticed only three or four months before admission. The Matas operation was performed July 29, 1904. The tumor was the size of a goose-egg. The technique applied in this case is identical with the preceding Observation 12, less the accidents referred to in that observation. Dr. Bullock writes June 15th: "As to the technique, where it was possible, I followed the directions laid down by you in your original article (*Annals of Surgery*, February, 1903). The only modification I found necessary to apply was one of detail depending upon the location of the openings of the artery within the sac as follows: In my first case I found the openings of the artery in the bottom of the sac, requiring therefore no modifications. In my second case, the openings of the vessel were located in the outer wall of the sac, nearer the superficial than the deep surface. The vascular openings were closed by sutures as advised, the infolded tissue being taken from adjacent inner wall of the sac. This left a deep hole below the level of the openings which was obliterated by two rows of sutures passing from one lateral wall of the sac to the other. After the floor of the sac had thus been brought to the level of the closed vessel, all that was left of the aneurysmal cavity lay to the outer side of the incision. This was held in apposition by the deep stitches tied over gauze pads as in the original operation. My third case (the present observation) was almost a counterpart of my second, the openings in this case, however, occupying the inner wall of the sac, lying, as in the preceding case, nearer the skin than the deep surface. This was similarly dealt with. In all three cases the superficial, endothelial, and subendothelial layers were very friable, necessitating very deep stitching to prevent cutting through. In my last case (Observation 13) I forgot to scrub the interior of the sac, but this did not interfere with primary union. Van Horn's ten-day chromic catgut No. 1 was used in the last two cases for occluding the vessel, No. 2 being used in the first case. The distance between the openings of the vessels within the sac in all three cases was almost the same, an inch to an inch and a quarter. Union *per primam* took place in this case. Slight swelling of the

leg persisted for about two months. The patient has been working as a laborer ever since. No recurrence (June 6, 1905).

Observation 14. Dr. J. A. Danna, New Orleans, La. (Operator's first case.) In an article, "The Matas Operation for the Radical Cure of Aneurysm, as Applied in Two Cases of Ruptured Aneurysm," *Journal of the American Medical Association*, July 8, 1905. *Fusiform (traumatopathological) aneurysm of middle femoral; operation immediately after rupture of the sac; complete hemostasis secured by suture of the orifices within the sac; discovery of an additional small aneurysm one and a half inches above the lower first operated upon, and ligation of the femoral above the last aneurysm; recovery.*

White male, laborer, aged forty years. Moderate alcoholic and arteriosclerotic; good hereditary and antecedent history. Admitted to the Charity Hospital August 1, 1904. Discharged after serving as help in the ward, October 13, 1904. Only two weeks before admission, while at work, noticed a swelling in the inner side of right thigh (largest above middle third). On admission the following condition was observed: A large tumor situated on the inner and anterior surface of the thigh, largest in middle thigh. Lower pole four to five inches from patella. Upper pole directed upward and backward and extending almost to ramus of pubis. Tumor hard, but fluctuating. No pulsation; no thrill; no bruit. No pulsation in dorsalis pedis; œdema of left foot. Constant severe pain in tumor and entire lower limb, growing steadily worse.

*Operation, August 4th.* No positive diagnosis. Diagnosis rested between sarcoma and aneurysm. Exploratory incision; preliminary traction loop of silk thrown around the common femoral to secure provisional hæmostasis. Free incision into the mass and found a huge aneurysmal pouch containing an immense amount of clot of dark-looking blood. After mass of clot was removed two openings were seen at the upper and lower parts of the sac which were bleeding freely. A purse-string silk suture placed around each orifice and over this a row of silk Lembert suture controlled bleeding at once. Dr. Danna on further exploration found that the sac, which was immense, had previously ruptured at its anterior

and inner border and that the blood had directed its way up and down under the muscles and clotted. All these clots (several pints) were removed and the cavity well irrigated with hot saline solution. The temporary traction ligature controlling the femoral was removed and no bleeding occurred. The femoral was felt pulsating up to a point one inch above the upper opening of the sac. As he was preparing to close the sac, the operator saw and felt an aneurysmal dilatation of the femoral, small, size of a hen's egg, about an inch above the upper opening of the aneurysmal sac, which he had just closed by suture. He put a ligature of stout silk above this. The enormous cavity of the aneurysm was partially closed with buried sutures and partially packed with gauze. The skin incision was closed all but its lower part, which was left open for drainage. The wound was dressed on the sixth day after operation and the pack was removed. The highest temperature after operation was 100°. Foot remained warm from time of operation and in a few days pulsation could be felt in the dorsalis pedis. The wound healed completely in three weeks, and the patient was discharged well on October 13th, having remained over to help in the ward after his convalescence.

Observation 15. Dr. John H. Gibbon, Philadelphia, Pa., operator. *American Medicine*, August 19, 1905, vol. x., No. 8, under the title of "The Matas Operation for the Cure of Aneurysm, with the Report of a Case." *Popliteal (traumatopathological) aneurysm.*

The patient was a negro, aged thirty-one years. At the time of his admission, October 27, 1904, the aneurysm was about the size of two fists, and could be easily seen projecting beyond the normal line of the leg on each side. The leg and foot were so enormously swollen as to resemble a marked elephantiasis. The patient stated that eight or nine months previous he had been struck with a stick in the back of the leg, and attributed the development of the aneurysm to this injury; he denied syphilitic infection. There was no difficulty in making a positive diagnosis of aneurysm of the popliteal artery, as all the typical signs were present. After two days' rest in bed the œdema of the leg greatly decreased, but

we were never able to detect any pulsation in either the anterior or posterior tibials. Two days after admission, after elevating the leg and applying an Esmarch constrictor well up on the thigh, I made a long incision in the middle of the popliteal space over the aneurysm. The sac was laid freely open from end to end, and a quantity of liquid blood and clot in various stages of organization evacuated. At the upper and lower part of the sac could be demonstrated the opening of the vessel. I thought for a while that it must be a sacciform aneurysm, as I could not find the point of exit of the artery, but finally was able to do so near the upper part of the lower end of the sac; in other words, the sac had developed posteriorly and extended under the inner head of the gastrocnemius. Because of the shape of the sac it was impossible to re-establish the calibre of the vessel, and I therefore followed Matas' plan of closing the openings of the artery with a small chromicized suture carried on an ordinary curved intestinal needle. I found no openings of collateral vessels in the sac, and, therefore, loosened the constrictor. There was no bleeding even after this was done, and I therefore thoroughly cleansed the sac, rubbing its interior with weak mercuric chloride solution followed with salt solution. The sac was then entirely obliterated with repeated rows of chromicized gut sutures. There was considerable oozing from the cut edges of the sac, but this was controlled by a whip stitch. The skin was closed entirely and a dressing applied. After the operation the patient did well, but on the second day his temperature rose to 103°, and he complained of considerable pain in the leg. As he had had increased temperature before the operation, I did not think it was due to infection; this idea, however, was an erroneous one, as within a few days there was evidence of infection of the wound. The stitches of the skin were removed and a large quantity of pus evacuated. After this the temperature fell and the patient was much more comfortable. The circulation remained good in the foot. The heel became sore some days after the operation, and there developed a necrotic area about the size of a silver dollar. This was undoubtedly due to pressure, which should have been avoided. It is now practically well, but has given

the patient more trouble than the popliteal wound. There was considerable contraction of the leg after removal of the splint, but now he is able to extend it to nearly a normal degree. There still remains an irritated scar in the popliteal region. This is due, I think, to the want of care which he has given to it since he left the hospital. During his convalescence he took very large quantities of potassium iodide with impunity, and he is now taking 2 gm. (30 gr.) three times a day. There is no evidence of a redevelopment of the aneurysm.

Observation 16. Dr. J. A. Danna, New Orleans, La. (Operator's second case.) (See Observation 14 for bibliographical reference.) *Large ruptured popliteal (traumatopathological) aneurysm.*

H. W., aged thirty years, was admitted to Ward 4, November 25, 1904.

*History.* Family history is negative. The patient smokes, chews, and drinks. Former diseases: both legs broken seven years ago at junction of middle and lower third. He was in a railroad wreck one and a half years ago and received general contusions. He had gonorrhœa seven years ago, but denies having had syphilis. The present complaint began in June, 1904, with pain in middle third of left tibia, extending to the ankle. This pain constantly increased. About November 1, 1904, the patient noticed a pulsating painful tumor in the left popliteal space. This tumor became smaller under treatment of pressure applied with a cork and bandage. He tried this plan about one week then he took the bandage off and began hard work in a saw mill. He worked ten days, when he noticed that his left ankle was swollen and he had a severe pain in the leg. The tumor appeared again in the popliteal space and began to grow much larger and became more painful.

*Examination.* There was general arteriosclerosis and an aortic obstructive murmur. There was a large, pulsating, expansile tumor occupying the left popliteal space, which increased one inch in size (circumference around knee) when pressure had been made above and released. A bruit could be heard over the tumor and over the femoral artery at Poupart's ligament. There was no

pulsation in the posterior tibial artery. Pressure below did not increase size of tumor.

*Treatment.* The patient was put to bed and ordered potassium iodide, grains 10 t. i. d., and the dose increased 1 grain daily. On November 27th an ice-bag was applied to the knee, codeine sulphate ¼ grain, was given and the leg was elevated. Temperature at this time was 98°, pulse 96, respiration 24. The patient complained a great deal on that day. About 2 P.M. the pain suddenly ceased. At 4 P.M. temperature was 101°, pulse 120, respiration 24. Examination of the knee showed a soft, fluctuating mass to outer side of and above the patella. At 7 P.M., a ruptured aneurysm having been diagnosed, he was taken to the amphitheatre and prepared for operation.

*Operation.* Under chloroform anæsthesia, ether being substituted later, an elastic constrictor was applied in the upper part of the thigh and a longitudinal incision of about three and a half inches was made over the centre of the tumor in the popliteal space, and a large cavity filled with clotted and fluid blood was exposed to view. After washing out the blood and clots the cavity was seen to be about six inches in longitudinal and four inches in transverse diameter. Its upper boundary was not so well defined as the lateral and lower ones, the blood having evidently dissected its way under the hamstring muscles on the outer side, and between them above, where the cavity ran up into a point. On the inner aspect and near the bottom, the wall of the cavity presented an area about one and a half inches in diameter and two and one-half inches in length, which was whiter and more smooth and glistening than the rest of its surface, which was of a dark and bloody hue. This proved to be the original aneurysmal sac, there being one opening in it near its upper margin and one near its lower, and about one and a half inches apart. These openings were closed with Lembert sutures of small silk on a curved needle, and, as an additional safeguard, a suture was passed completely encircling the upper opening and tied. On the removal of the elastic constrictor there was no bleeding whatever. The cavity was once more flushed with hot saline solution and packed with gauze and

a large dressing applied. The limb was wrapped in cotton batting and a posterior splint of pasteboard applied to immobilize the knee. Hot cans were applied around the limb for two days. The toes were felt to be warm, however, on his return to the ward from the operating room, and the wound healed from the bottom by granulation. He made an uneventful recovery, being discharged from the hospital cured on January 9, 1905.

Observation 17. Dr. Geo. R. White, Savannah, Ga., operator. Published in *Georgia Practician*, Savannah, Ga., January 15, 1905, vol. i., under the title of "Femoral Aneurysm Cured by Matas' Operation, Leaving the Artery Intact."

"The patient was a negro who had received a stab wound of the upper part of the thigh about four months previous to the operation. Two months later he noticed a swelling in the upper part of the thigh, which rapidly increased in size. When first seen, just previous to the operation, there was a tumor the size of a large cocoanut involving the whole anterior surface of the right thigh and presenting all the characteristic symptoms of an aneurysm.

"The operation was performed October 31, 1904. The limb was rendered bloodless, a tight tourniquet applied, and the sac was split vertically its entire length. After turning out the clot and wiping all the fibrin from the walls of the sac a small opening, about the diameter of a lead-pencil in size, was found, communicating with the femoral artery; but whether this communication was above or below the bifurcation could not be determined. Following Matas' directions (*Annals of Surgery*, March, 1903), the opening was closed by a row of fine, interrupted catgut sutures exactly as one would close a wound of the intestines by Lembert's method, but with the exception that the sutures were closer together and were inserted deeply into the tissue surrounding the opening. This first row of sutures was reinforced by two superimposed rows, and the cavity of the sac was obliterated by the ingenious method described by Matas. The entire limb was bandaged lightly and reinforced by a Martin rubber bandage applied over all. The tourniquet was then removed and pulsation in the posterior tibial artery was resumed immediately. Three weeks

later he was allowed to sit up, and returned home five weeks after the operation.

"This was a case of traumatic, sacculated aneurysm which presented unusually favorable conditions for a conservative operation. The walls of the sac were in good condition and there was but one small opening to be closed. Had it been operated upon by one of the methods usually employed for such cases the artery would have been sacrificed with a probability of producing gangrene of the leg.

"Although the operation is a new one this is the second time that it has been done in Savannah. The other was a case of fusiform popliteal aneurysm operated upon by Dr. Craig Barrow and cured, leaving the lumen of the artery intact."

OBSERVATION 18. Dr. Willy Meyer, New York City, operator. Personal communication, dated April 20, 1905. *Traumatic aneurysm of popliteal artery; sacculated; closure of the orifice of communication without obliteration of the main artery; Matas' technique throughout; union per primam; recovery.*

S. J., male, aged eleven years. When attempting to trim down a stick (while in the country, in August last), pressing the same down against his right thigh with one hand, the leg being flexed at knee and hip, the knife slipped and entered the outer aspect of the lower third of the thigh. Immediate serious hemorrhage. Color not known to the boy. He was carried to the hotel where he was staying with his parents, one-quarter mile away, during which time the hemorrhage continued uninterruptedly, so that he soon became unconscious. One of the guests at the hotel applied a tourniquet with a towel. A physician was called who closed the wound by stitches and removed the tourniquet. The boy remained in bed for ten days, when the wound was healed, but the knee appeared stiff, the patient being unable to bend it properly. A week later he was taken to the city, where the family physician made some passive exercises with the extremity. Four weeks after the injury the boy noticed a small tumor in the popliteal space, causing some throbbing. This slowly increased in size and, when first seen by me November 24, 1904, had reached the size of a

small apple, with all the clinical symptoms of an aneurysm. There was a scar visible in the region mentioned above.

*December* 1, 1904, *Matas' Operation.* Esmarch's bandage. Longitudinal incision of skin and sac. The latter lies somewhat above the popliteal space, contains blood, mixed with clots, and numerous lamellæ adherent to its inner surface. Adherent clots removed with sterile gauze (rubbing), when it is seen that the entrance into the aneurysm is at its lowest pole. Probe passes upward and downward from this point, proving the aneurysm beyond doubt a sacculated one. Suture of communicating hole from within, with a continued silk suture, leaving in position a large-sized probe that had been introduced into the tibial artery. This presses the anterior wall of the sac well downward, so that the suture is continued in a horizontal line. After the hole has been well traversed by needle and thread, the probe is removed and the suture continued to the upper pole of the aneurysm. Removal of Esmarch bandage. No hemorrhage beyond some slight capillary oozing from various parts of the sac. Three additional continuous layer sutures of chromicized catgut, closing the sac in its entirety. Then two transfixing sutures are put in at either side, pressing the skin down to the sac. Continued skin suture. Uninterrupted recovery. Change of first dressing on the tenth day, when it was found that the entire wound had closed. For safety's sake—the boy being the only child—he was kept in bed for two and a half weeks and discharged at the end of the third week. At the present time (nearly five months since operation) he has recovered full use of his limb.

Observation 19. Dr. F. W. Parham, New Orleans, La., operator. Synopsis in Proceedings of Orleans Parish Medical Society, February 11, 1905. Personal communications. *Popliteal aneurysm (traumatopathological); fusiform type.*

"W. P. C., aged fifty-five years. In August, 1904, while walking on the mountains of Kentucky, he stepped on a round stone, which turned under his foot. He felt some soreness in the leg that night, and from that on his trouble began. When examined at the N. O. Sanitarium, on December 12, 1904, there was nothing

noteworthy in the general condition, except that there was a distinct apical regurgitant murmur, of which the patient had been aware for a long time. The popliteal space, especially its lower half, showed distinct pulsation with expansion, but the tumor, while quite evident, did not show conspicuous bulging.

"On December, 13, 1904, I operated upon him in the following manner:

"The leg having been properly prepared up to the level of the ischial tuberosity, he was put under the anesthetic, turned over on his abdomen, and an Esmarch bandage applied from the toes up to a point somewhat above the middle of the thigh where the constrictor was fastened. The operation was then begun by making a long incision through the middle of the popliteal space, about over the centre of the aneurysm. Dissection was carefully made down to the aneurysmal sac, which was with difficulty brought into view, owing to its situation on the postero-external aspect of the artery, and also on account of four or five large turgid veins running directly over the sac. This was due to the fact that the constrictor had not been sufficiently tightly applied, and it had to be tightened up. This is mentioned specifically, as it seems to have some bearing on the subsequent suppuration. Several of these large veins had to be tied either by circular ligature or by lateral, and the aneurysm was finally reached and opened. A large amount of clot was turned out with the fingers, disclosing a rather irregularly shaped sac, springing from the postero-external aspect of the artery and projecting anteriorly, the popliteal skin being only slightly bulged out. About three inches of the vessel wall seemed to be involved in the dilatation and about one-half its circumference, leaving about one-half the lumen presenting as a distinct trough, situated posteriorly and to the inner side of the sac proper, so that when the sac was laid open the cavity was seen to consist of two parts, the smaller, the arterial trough above mentioned, lying posteriorly and to the inner side, and the larger, or aneurysmal sac proper, projecting anteriorly and to the outer side. The aneurysm was so overlaid by the tissues of the ham that this vascular groove was only discovered after a

somewhat prolonged exploration of the sac. When found, it served as a guide to the upper and lower openings of the sac, which had for some time eluded a most careful search. The upper orifice was first sutured from within by chromic-gut sutures in a round needle, taking deep bites, and then the lower opening in the same manner. Finally, a continued chromic-gut suture was carried from the lower opening to the upper, about three inches, converting this practically into a fibrous cord, thus thoroughly obliterating it. The sac could not be closed by Lembert-like inversion sutures, owing to its being so deeply imbedded in and firmly adherent to the surrounding tissues, so I could only place a deep drain of gauze and depend upon such approximation as could be effected by the superficial sutures and a large dressing snugly bandaged on a posterior pasteboard splint. When the constrictor was released there was considerable venous hemorrhage, which was controlled by a number of ligatures. The wound was sutured completely, except where the drain came through, and a large dressing, enveloping the whole extremity from toes to groin, was applied. Two days after the operation the drain was removed and the dressing re-applied. All went well without any evidence of local sepsis for about a week following the operation, when I dressed the wound, merely to see how it was getting along. I found it had opened and a considerable quantity of pus was discharged. I opened the wound more freely so as to pack it with iodoform gauze, and continued to do this for some days.

"On January 9th he left the Sanitarium for his home in very good general condition, with the wound discharging very little, though still open. I continued to dress him for a few weeks longer, until the wound was entirely healed.

"May 16th he visited my office, in excellent condition, with no evidence of return of the aneurysmal pulsation. Some pulsation could be felt at the upper part of the popliteal space, but this was clearly nothing more than the pulsation of the artery above the aneurysm. The dorsalis pedis artery could be quite distinctly felt. The posterior tibial could not be made out at all."

Observation 20. Dr. Robert Abbe, New York City, operator. Personal communication dated May 22, 1905. *A case of popliteal aneurysm (traumatopathological) cured by Matas' aneurysmorrhaphy.*

Patient, male, aged forty years, accustomed to heavy packing-case lifting, knows of no special injury. Tumor, of three months' development, in the right popliteal space, size of half an orange. Marked expansile pulsation and bruit.

*Operation: Saint Luke's Hospital, New York, January* 17, 1905. Median incision over the tumor. No sac wall posteriorly except condensed cellular tissue and lymph. Aneurysm tending to dissect by lateral diverticula with same walls. Some firm clots added to strength of the posterior wall. Anterior popliteal wall sound. Posterior arterial wall had given way for four centimetres. At either end of this defect the calibre of the artery formed a full opening. The artery was closed by interrupted chromic-gut stitches with one extra occluding stitch at each end. A continuous, fine, chromic-gut stitch inverted the tissues over the line of the first row. Over this a compressing dressing of gauze and adhesive straps brought the raw cellular walls together. No attempt to unite the skin by sutures, as the edges opposed well by dressing. Primary union. A febrile convalescence. Even with this limited arterial suturing the vitality of the foot seemed in jeopardy for two days, and demonstrated the peril to which it would have been subjected had a femoral ligation been done. Full use of the foot was permitted after four weeks. The scar remained strong.

Observation 21. Dr. Francis H. Markoe, New York, operator. Reported in personal communication, by Dr. H. H. Lyle, dated October 28, 1905. Sacculated, traumatic aneurysm; obliteration of sac with preservation of arterial lumen.

Nicholas P. (New York Hospital, No. 27330). Male, aged seventeen years, admitted July 12, 1904; discharged August 12, 1904.

*Family History.* Negative.

*Previous History.* Unimportant.

*Present History.* On December 16, 1903, a knife was thrown, the point of which, striking him in the left popliteal space, inflicted

a small wound. Within a few days he noticed a small swelling. This swelling was accompanied by dull, aching pain. The pain was increased by walking and at times became quite acute, radiating up to the inner thigh and down to the ankle. At such times he would find relief by flexing his knee. Gradually this position became habitual. From this time on the patient noticed no untoward symptoms, until July 4th, when after unusual exertion the pain became very severe, only relieved by rest and sharp flexion of the knee.

*Physical Examination.* General condition good; heart and lungs normal; abdomen normal.

*Surgical Condition.* There is a smooth, pulsating tumor the size of an orange in the right popliteal space. At the summit of the swelling there is a fine linear cicatrix. There is an expansile impulse, most marked in the upper quadrant; this is accompanied by a distinct thrill. The lower limit of the tumor is marked by a line between the condylar tubercles. Length, 10.5 cm.; width, 8.5 cm.; projection, 3 cm.; capillary circulation in the foot poor; the pulse in the dorsalis pedis feeble.

*Operation, July* 13, 1904. Gas and ether. Dr. Francis Markoe. Leg elevated and Esmarch bandage applied. A median vertical incision 8.5 cm. over the tumor. The sac was opened and a firm clot removed, revealing a smooth, white floor, with an opening 1.25 cm. in the median line. The walls of the sac were of moderate thickness. It was impossible to ascertain whether it was a true or a false aneurysm. The opening was closed without obliterating the lumen of the popliteal artery by a continuous suture of fine chromic; over this the sides were infolded, with a similar suture, and this in turn reinforced likewise. The skin was closed with silkworm gut and the leg immobilized in plaster.

The patient made an uninterrupted recovery, the wound healing by primary union. The circulation in the foot was restored immediately after the operation. Discharged August 12, 1904, cured. Slight fulness in the popliteal space. No induration. Pulsation normal. Circulation in the foot normal. Flexion at the knee normal.

*Examination February* 2, 1905. Wound represented by a soft linear cicatrix, no bulging, pulsation normal.

*Examination October* 27, 1905. Pulsation normal. Patient has been working steadily since leaving the hospital, without any inconvenience whatever.

*Pathological Report* (No. 8771). The material consists of: 1. A piece of dense membrane, elliptical in shape, 1 mm. in thickness, 6 cm. in length, 4 cm. in width. The concave surface is covered with a firm, stratified fibrin. 2. A firm blood clot, 6 x 4 x 1 cm.

*Microscopic Examination.* The section shows dense, fibrous tissue, with a moderate amount of round-celled infiltration between parallel bands of fibrous tissue. There is no sharp line of division between the wall and the fibrinous clot adherent to its inner surface. No elastic or muscular tissue can be demonstrated. The aneurysm is thought to be a false one.

Observation 22. Dr. D. N. Carpenter, U. S. N., operator. U. S. Naval Hospital; Puget's Sound, Washington; Personal communication, October 27, 1905, *femoral; fusiform; traumato-pathological aneurysm; obliteration of the orifices and sac by Matas' method.*

" P. C. J., aged thirty-eight years, chief boatswain's mate, U. S. N. In July, 1905, while on the U. S. S. Boston, he slipped and fell. Immediate pain and numbness of leg followed, lasting several days. Then a decided swelling of thigh was observed. The condition of the sac found at the operation confirmed the impression that something had snapped in the thigh during the fall. The sac was of the fusiform type, with two thick poles corresponding to the proximal and distal ends of the artery, and separated by a very thin-walled intervening sac, which suggested that the artery had parted or given way at a diseased point, or in the centre of pre-existing aneurysmal dilation. The patient was admitted to the hospital with marked femoral aneurysm of the left thigh, beginning at the apex of Scarpa's triangle, and extending over the length of Hunter's canal. The sac was of moderate size, but pulsated vigorously. Tuffnell's treatment, with rest in

bed, and K. I., was tried, but this had to be abandoned in three weeks. Then Reid's method with the Esmarch bandage and tourniquet was applied, but the patient was only able to stand the tourniquet for an hour, when the extreme pain compelled its removal. The Pettit tourniquet was substituted and kept on for six hours, with gradual release of pressure. As a result of this treatment the leg became greatly swollen, with superficial petechial hemorrhages. The only benefit obtained was a partial decrease in size, with a less pronounced pulsation from increase of clot.

"On September 14, 1905, I operated by Matas' method. After cutting through the skin, fascia, and adductor the sac was reached and opened freely. Clots were removed; there was troublesome hemorrhage from the lower (distal) opening of the sac, which ceased when the tourniquet was tightened. Dense, fibrinous laminations lined the sac, and were not entirely removed by scrubbing with saline solution. Following the fusiform dilatation of the healthy artery at either end I found a thin-walled, central sac, with thick-walled dilated poles, leading to the affected artery at the proximal and distal ends, in the manner previously described in the introduction. I had considerable difficulty in finding just the right needle to use, and also with the fibrinous laminations which lined the orifices, and which cut through when I tried to tie my sutures, believing I had the walls of the artery or sac. I finally managed to insert and tie four sutures at either end through the thick walls and then remove the tourniquet. There was no bleeding, and I continued the sutures by pleating the walls of the sac. Lastly I sutured the muscle fascia and skin, leaving a small gauze wick for drainage. Time of operation, two hours. Patient reacted well, but had considerable pain during the first night (leg kept elevated, wrapped in cotton, in wire gutter, surrounded by hot-water bags). The second day he had pulsations of dorsalis pedis and no pain. On the fourth day there was much pain in wound and high fever. The wound was examined, but there was no redness or swelling until the fifth day, when deep infection was found and the wound freely opened, irrigated, and dressed.

The subsequent course has been uneventful. The wound has gradually healed from the bottom, forming occasional pockets and discharging chromicized sutures. Again, on December 1, 1905, Dr. Carpenter writes: "The patient is still at the hospital, with a small sinus leading to the upper part of the sac. One by one the many chromicized gut sutures have been discharged, apparently unchanged, and with each new suture the wound has closed more, until now it is believed that only 'one more' remains. He is perfectly well, walks everywhere, works in the ward, and would have been discharged several weeks ago were it not for the dressings necessary.'"

OBSERVATION 23. Service of Dr. R. Matas, Charity Hospital, New Orleans, La.; Dr. J. D. Danna, First Assistant House Surgeon, operator. *Popliteal aneurysm; fusiform; traumatopathological (?): complete reconstruction of the artery out of the sac walls by arterioplasty; relapse; obliterative endoaneurysmorrhaphy; (Matas' method); cure.*

G. M., colored, aged forty years, laborer; admitted to Ward 1, Charity Hospital, October 25, 1905. Alcoholic, smoker, and is markedly arteriosclerotic; was shot in left thigh, near groin, seventeen years ago; wound healed with no complication.

Three weeks before admission the patient noticed a swelling in the left calf, which was accompanied by pain and tenderness. This grew worse slowly and was followed by edema of the foot, which gradually crept up to the popliteal space. When admitted a distinct pulsating tumor filled the left popliteal space. In the absence of Dr. Matas, the chief of the service, Dr. Danna attended the patient, and operated on October 27; spinal analgesia with cocain 1/5 grain. After applying a constrictor to the upper third of thigh an incision was made to the aneurysm. The sac was opened on the outer side of the popliteal space, which was its thinnest and most superficial part, and a mass of clot evacuated. After opening the sac it was found that this had dedeveloped from the anterior part of the artery and had expanded toward the joint, leaving the main trunk lying on the inner and superficial aspect of the tumor, with the sac projecting toward

the joint and to the outer side of the space. The proximal and distal openings of the popliteal artery were located in the roof of the sac, separated by an interval of about three inches. The walls of the sac appeared to be fairly strong and resistent, and Dr. Danna decided that he would try to reconstruct the vessels by utilizing the walls of the sac. The ends of a piece of soft-rubber catheter were introduced into each orifice and the walls of the sac were sutured over the catheter with a single row of interrupted Lembert sutures, the catheter being removed before the final sutures were tied. The sac was then obliterated by three mattress sutures inserted from within. The incision on the outer side of the sac was closed with interrupted sutures; the skin and fascia being approximated by the same method without drainage. Upon removal of the constrictor, the dorsalis pedis artery on the affected side could be felt to pulsate as strongly as on the healthy limb. The limb was put up with a posterior cardboard gutter splint and the patient sent to the ward.

No notable events followed the operation, the wound healing well, with the exception of a single stitch abcess. On November 20 (twenty-four days after operation) distinct, expansile pulsation was noted in the popliteal space, and it became evident that the aneurysm had relapsed. It was learned that on or about November 16 (about twenty days after the operation) the patient got out of bed and skylarked around the ward with another patient. No ill effects of this had been noticed at the examination of November 18. On November 23 (twenty-seven days after first operation) the patient was again brought to the operating room, where Dr. Danna, assisted by Dr. Matas, operated a second time; second operation: Scopolamin gr. 1/150 and morph. sulph. gr. 1/8 were given hypodermically one hour before the operation. An attempt was made to give ether, but the patient took the anesthetic so badly that he was allowed to come out of the anesthetic, and 10 minims of a 4 per cent. cocain hydrochlor. were injected into the spinal canal. Esmarch bandage and constrictor were applied about the middle of the thigh. An incision was made directly over the old scar and a small clot of blood was pressed out of the subcutaneous

tissues. The incision led into the cavity of the old sac, which had been refilled with blood by a rupture of the new artery constructed by Dr. Danna twenty-seven days previously. The new arterial canal was recognized and showed a rupture in its lower fourth, just where it entered into the outlet of the sac. The upper three-fourths of the new channel held perfectly, the sutures giving way only at the seat of the rupture. The conditions were very similar to those described by Dr. Morris in his case, the relapse having occurred as a result of the outpour of blood from the ruptured new vessel into the old sac. The new vessel was now laid open by cutting the sutures that held together what remained of the new vessel, and the arterial orifices, which constituted the original outlet and inlet of the aneurysm, were laid bare and sutured by a series of interrupted sutures which penetrated the entire thickness of the tissues about the lips of the openings. These sutures made with chromic gut completely occluded the orifices. On the removal of the constrictor, the hemostasis was complete.

The skin edges were freshened and the wound closed with silkworm sutures, a central wick drain of iodoform gauze being inserted. The color and temperature of the foot was normal at the close of the operation, though the pulsation of the dorsalis pedis could not be felt. The recovery of the patient after this operation has been uneventful. The wound healed rapidly by granulation after the removal of the gauze pack. No purulent discharge at any time. Returning pulsation in the dorsalis pedis could be felt on the thirteenth day after the operation. Patient's general condition excellent, and on December 18 (twenty days after the operation) the patient became impatient to return home, in St. Gabriel, La., where he is now actively at work as a plantation laborer.

Observation 24. Dr. J. A. Danna, M.D. (Operator's fourth case.) *Femoral, fusiform (?), aneurysm; traumatopathological obliterative endoaneurysmorrhaphy.*

J. F., negro laborer, aged thirty-two years, admitted October 30, 1905. Gives an excellent history: has never been seriously sick

in his life, though he indulges in alcohol and tobacco. Attributes his present trouble to a severe kick of the thigh, inflicted eleven years before. The aneurysmal swelling was not recognized, however, until August, 1905, three months before admission, when he was struck accidentally on the left thigh with the handle of a spade, precisely on the spot where a mule had kicked him eleven years previously.

On admission, the patient presents a swelling the size of a cocoanut, about the middle of Hunter's canal. First noticed about August 1, 1905, the size of a walnut, gradually increasing in size since. Pulsation and no pain from beginning to September 15. Pulsation imperceptible to patient, but constant, severe pain since September 15. Examination: no bruit; slight expansile pulsation.

*Operation*, October 30.—Spinal analgesia (10 minims 4 per cent. cocain sol.). Elastic constrictor. Longitudinal incision through skin, fascia, and thinned sartorius. Sac filled with semi-solid clot (650 grams) and very little fluid blood. Large, irregular cavity, bottom divided in two by longitudinal ridge containing nerves and vessels, which were visible through thin sack wall. One opening in upper wall. None other found after diligent search. Three sutures of silk obliterated the orifice; buried by additional layer of four superimposed interrupted stitches. No bleeding on removal of constrictor. Incision partly closed by through and through silkworm-gut sutures and packing and drainage. Leg as warm as its mate soon after. Pulsation in dorsalis pedis next day. Uneventful progress toward recovery. Patient left the hospital without permission on December 5, with his wound practically healed.[1]

## GENERAL SUMMARY.

From March 30, 1888, to 1903, 4 cases; from 1903 to December 10, 1905, 20 cases; total cases, 24. Sex: female, 1; males, 23.

[1] The addition of observations 22, 23, and 24, since the meeting of the Association in June, has compelled a revision of the first synopsis of the supplement, which now follows in its amended form.

*Operators:* Fifteen. Matas, 5; Danna, 4; Gessner, 1; Parham, 1; equal 11 in New Orleans; Bullock, of Lexington, 3; Robert Morris, 1; W. Meyer, 1; Robert Abbe, 1; F. Markoe, 1. Total in New York City, 4. J. F. Binnie, Kansas City, 1; Craig Barrow, 1; George R. White, Savannah, 1; Gibbon, Philadelphia, 1. Pantzer, Indianapolis, 1; D. N. Carpenter, U. S. N., Puget Sound 1; total 24.

*Anatomical Classification.* Popliteal, 16; femoral, 6; brachial, 2; total, 24; equal 66.6 per cent. popliteal.

*Etiological Classification.*[1] Traumatic (clear history of trauma, shot, stab, etc.), 6 cases (Matas, 2; Pantzer, 1; White, 1; W. Meyer, 1; Markoe, 1); total, 6; equal 28.5 per cent.

*Traumatopathological.* A distinct history of some traumatism (strain and lifting, indirect falls, moderate blows, etc.) associated with a pathological arterial basis (syphilitic, alcoholic, arteriosclerotic), total 8 cases. Matas (fourth and fifth cases), 2; Bullock (first and third cases), 2; Gibbon, 1; Danna, 3; Parham, 1; Abbe, 1; Carpenter, 1; total 11.

*Pathological.* 7 cases (history of arterial disease without clear, definite, localizing trauma). Matas (third case), 1; Morris, 1; Binnie, 1; Barrow, 1; Gessner, 1; Bullock (second case), 1; Danna (first case), 1; total 7.

TYPE OF ANEURYSMAL SAC.

*Fusiform.* 17 cases; 70.8 per cent. (Two openings in the sac leading to parent artery with a variable interspace between them.) Matas, 4; Bullock, 3; Morris, 1; Barrow, 1; Gessner, 1; Danna, 4; Gibbon, 1; Parham, 1; Carpenter, 1.

*Saccijorm.* 7 cases; 29.2 per cent. (Single main opening com-

[1] In accordance with accepted teaching, it is more than probable that the cases grouped as "pathological" should be classed as "traumatopathological," as there is always some direct or indirect traumatism which determines the localization of aneurysms in conditions of general arterial disease. The distinction of "pathological" is made in the absence of a clear, recognized, local, determining cause. This distinction is useful probably in accentuating the preponderance of the pathological over the traumatic element in the causation.—E.

municating with parent artery.) Matas, 1; Binnie, 1; Pantzer, 1; White, 1; W. Meyer, 1; Abbe, 1; Markoe, 1.

### TYPE OF PROCEDURE ADOPTED IN OPERATION.

GROUP 1. *Author's original technique* (*typical obliterative endoaneurysmorrhaphy*). Suture of all orifices in the sac, with obliteration of the artery; all, except 3, were fusiform sacs. Total, 17 cases; 70.8 per cent. Matas, 5 (1 sacciform); Bullock, 3; Binnie, 1 (sacciform); Gessner, 1; Danna, 3; Gibbon, 1; Parham, 1; Abbe, 1 (sacciform).

GROUP 2. *With restoration of the lumen of the main artery.* Total, 7 cases; 29.2 per cent. Morris, 1; Barrow, 1; Pantzer, 1; White, 1; Meyer, 1; Markoe, 1; Danna, 1.

### SUBVARIETIES OF GROUP 2.

(*a*) Complete restoration of the continuity of the lost artery in the sac by arterioplasty (author's technique); three fusiform aneurysms. Morris, 1; Craig Barrow, 1; Danna, 1.

(*b*) The lumen of the parent artery restored by closure of the single orifice of communication in the sac (author's method) in four sacciform aneurysms: Pantzer, 1; White, 1; W. Meyer, 1; Markoe, 1.

### TREATMENT OF THE SAC.

In no case was the sac extirpated or disturbed from its surroundings.

(*a*) Typical obliteration of the sac by the author's method (without drainage); total, 8 cases. Matas, 3; Bullock, 3; Barrow, 1; White, 1. Suppuration in three.

(*b*) Atypical total obliteration of sac by suture without infolding skin flaps into cavity ("Neuberizing") and closing wound over obliterated sac (without drainage); total, 8 cases. Morris, 1; Binnie, 1; Pantzer, 1; Gibbon, 1; Meyer, 1; Parham, 1; Abbe, 1; Markoe, 1. All healed per primam except three.

(*c*) Atypical partial obliteration of the sac by approximating walls and surrounding parts, with buried sutures (packing and drainage); total, 8 cases. Matas, 2; Danna, 4; Gessner, 1; Carpenter, 1.

### POSTOPERATIVE RESULTS.

Twenty-four cases.

(*a*) Deaths: none. One case died fifteen days after operation from associate pyelitis and nephritic complications (Pantzer's case).

(*b*) Gangrene or serious disturbance in circulation of affected extremity: none.

(*c*) Secondary hemorrhage: none.

(*d*) Relapses: (1) In obliterative endoaneurysmorrhaphy (17 cases), none. (2) In endoaneurysmorrhaphy with lateral or partial arterioplasty for sacciform aneurysms (4 cases). Pantzer, White, Meyer, Markoe: none. (3) In endoaneurysmorrhaphy with complete or circular arterioplasty (3 cases), 2 relapses (Morris, 1; Danna, 1). No relapse in Craig Barrow's case, 18 months since operation.

N. B.—One of the two relapsed cases (Danna's) cured by reopening the sac and suturing the orifices by the author's method of obliterative endoaneurysmorrhaphy, one month after first operation.

### ADDENDUM.

The list of twenty-four observations could be enlarged by the addition of three more cases in which the intrasaccular suture of the aneurysmal orifices has been applied in connection with the ligature or other procedures. The first of these is the interesting left subclavian aneurysm, operated upon by Drs. E. D. Martin and F. W. Parham, of New Orleans, on December 8, 1904. The patient was fifty-three years of age, and the aneurysm, a fusiform sac, of pathological origin, involved the second and third portions of the left subclavian. The tumor began just behind the scalene muscle and extended to the point of disappearance of the artery

under the clavicle, the outer half of which overlay it somewhat. Three-fourths of the clavicle were resected on the inner side. The first portion of the artery was ligated just inside the scalene muscle; temporary cessation of the pulsation; incision of the sac, followed by severe hemorrhage, finally controlled by suture of the proximal opening within the sac and distal ligation of the subclavian. The patient recovered gradually, after severe shock and considerable loss of blood. In this case the suture of the orifice of the proximal opening was necessary to control the bleeding of this orifice in spite of two ligatures applied to the vessel on the proximal side and close to the sac. The advantages of the sutures as hemostatic measure in controlling the bleeding in aneurysmal sacs is well shown in this case. This case will be reported in full by Drs. Martin and Parham in the *Transactions of the Southern Surgical and Gynecological Association* for 1905.

The second case is that reported by Le Fort of Lille, France (vide *Bull. et Mém. Société de Chirurgie*, Paris, 1903, N. S. 29; 1180-1185) in which a single, circular opening in a sacciform popliteal aneurysm (traumatic) was closed by suture without obliterating the artery. A second aneurysm developed on the second day after the operation at a considerable distance from the first lesion, compelling the operator to reopen the wound. In the course of the operation it was seen that the line of arterial suture had held perfectly and the return of the aneurysmal condition was due to a rupture of the popliteal at a lower point weakened by the same bullet injury. The popliteal vein was also implicated in this case. The patient, a man of fifty-two years, finally recovered after an extensive extirpation of the popliteal artery and vein. A successful suture of the left femoral artery (single opening) in the sac of a traumatic aneurysm is also reported by G. del Conte of the Incurabili Hospital, Naples, August 12, 1904 (*Gior. Internaz. d. sc. Med.* Napoli, 1905, N. S. xxvii. 392-398). In this case the sac was also partially extirpated. These three cases should be classed as atypical endoaneurysmorrhaphies.

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